

# THE BRONZE AGE SHIPWRECK AT SHEYTAN DERESI

A Thesis

by

ALEXIS CATSAMBIS

Submitted to the Office of Graduate Studies of  
Texas A&M University  
in partial fulfillment of the requirements for the degree of

MASTER OF ARTS

May 2008

Major Subject: Anthropology

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Approved by:

Chair of Committee,	Cemal Pulak
Committee Members,	Deborah Carlson
	David Woodcock
Head of Department,	Donny Hamilton

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## ABSTRACT

The Bronze Age Shipwreck at Sheytan Deresi. (May 2008)

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Chair of Advisory Committee: Dr. Cemal Pulak

During the fall of 1973, the newly formed (American) Institute of Nautical Archaeology conducted its first systematic underwater survey of the southwestern coast of Turkey with the goal of locating the first shipwreck to be subsequently excavated by the Institute. Of the 18 wreck sites identified during the survey, a site off Sheytan Deresi (Devil's Creek) proved to be the one that attracted George Bass, director of the survey, as most meriting further study. During the excavation that followed in September and October 1975, the site produced a number of complete and fragmentary ceramic vessels that formed the main artifact assemblage.

Although the ceramic vessels brought to light at Sheytan Deresi have been studied by George Bass, Roxani Margariti and others since the 1975 excavation, locating precise parallels for the assemblage proved a difficult task and resulted in a less than full understanding of the site.

The following thesis represents a renewed effort to answer a number of questions still surrounding the Sheytan Deresi site. In addition to expanding the extensive search for parallels undertaken by Bass and Margariti, recent research has involved a number of

scientific analyses, including petrographic analysis of the ceramic assemblage, luminescence dating of ceramic fragments, and elemental examination of the fabric through neutron activation analysis and energy dispersive spectroscopy. The use of three-dimensional modeling has been adopted for the purposes of site interpretation.

Although the impact of this more holistic approach cannot be entirely foreseen at this time, a number of interesting hypotheses regarding the site can now be suggested. It appears that the ceramic assemblage, which is now conclusively of a single origin, may be of a specialized maritime nature, and likely belongs to the Middle Bronze Age, reminiscent of, but entirely similar to, regional types of Anatolian and Cretan vessels. These tentative conclusions, as well as an examination of the site itself, suggest that the (Minoanizing) ceramic assemblage of Sheytan Deresi stood witness to a fairly small Middle Bronze Age coastal trading vessel that capsized rounding a dangerous cape, not far from its point of origin.

We are still not in a position to fully comprehend the wrecking event that took place at Sheytan Deresi, but we are now firmly on course towards reaching that objective.

## DEDICATION

To all those who stood by in support

## ACKNOWLEDGMENTS

During my first semester in the Nautical Archaeology Program I was entrusted by Drs. George Bass and Cemal Pulak with furthering the substantial work that had been undertaken on the Sheytan Deresi material, in hopes of achieving a final publication for this important site. It was with great humility that I accepted the task and warmly thank both for their trust and continuing support.

Deep gratitude is reserved for those who devoted hours of research on understanding the site and related finds. Whereas the completion of this thesis has not been an easy task to accomplish, it was certainly in large part made possible because of the shoulders of people more competent than I that I stood on. The importance of the contributions of Dr. George Bass and Dr. Roxani Margariti cannot be overstated.

The holistic approach adopted by the author in trying to better understand the Sheytan Deresi shipwreck could not have proceeded without the generous contributions and professional work of Dr. Yuval Goren (Department of Archaeology and Ancient Near Eastern Cultures, Tel-Aviv University), Dr. James Feathers (Director of the Luminescence Dating Laboratory at the University of Washington), Dr. Latha Vasudevan (Nuclear Science Center, Texas A&M University), and Dr. Michael Pedleton (Microscopy Laboratories, Texas A&M University). I am also grateful to Dr. C. Wayne Smith for introducing me to the world of three-dimensional modeling.

Gaining access to the material and permission to perform the various analyses was only possible because of the efforts of the conservation staff at the Bodrum Museum of Underwater Archaeology, together with whom we rediscovered the Sheytan Deresi artifact assemblage, and the support and encouragement of Yaşar Yıldız, Interim Director of the Museum. Netia Piercy deserves particular mention for the original drawings that are used as the basis for the majority of the artifact illustrations present in this thesis.

Drs. Deborah Carlson and James Woodcock, members of my Thesis Committee, both share my deep gratitude for their ever-present willingness to assist in any way, their valuable advice, and, in particular, their efforts and time devoted to the last phases of the manuscript.

Inspiration, drive towards a higher standard, reason, challenge, and support, even in the busiest of times, came from Dr. Cemal Pulak, Chair of my Thesis Committee, to whom I am indebted. I am also grateful to Dr. Pulak for assisting with the funds needed to complete the luminescence analyses, providing for them through his chair, as well as for being instrumental in Dr. Goren graciously undertaking the petrographic analyses for the ceramic assemblage.

Finally, on a personal level, I owe the warmest thanks and gratitude to the people close to me who stood with me through this phase in life, making their own sacrifices for my future. I hope one day to stand as firm by them.

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## CHAPTER I

### INTRODUCTION: THE SURVEY

Between August 21<sup>st</sup> and October 15<sup>th</sup> 1973, the newly formed (American) Institute of Nautical Archaeology conducted its first systematic survey of the southwestern coast of Turkey.<sup>1</sup> The objective of the survey was to locate the shipwreck that would be the first to be excavated by the young Institute. The expedition proved to be a success as 18 sites were identified, representing what appeared to be every period of antiquity since the Bronze Age.<sup>2</sup> In fact, in his subsequent report to the National Geographic Foundation,<sup>3</sup> the director of the survey, George F. Bass, identified eight of these sites as worthy of excavation. Only one of the sites, however, appeared to be un-looted;<sup>4</sup> it also happened that the same site was thought to be the oldest known wreck discovered at the time.<sup>5</sup>

Towards the completion of the survey well into October 1973, a sponge diver named Cumhur Ilık, upon the suggestion of Yüksel Eğdemir, then the representative of the Turkish General Directorate of Antiquities, led the team to the bay of Sheytan Deresi<sup>6</sup> (fig. 1). The bay was located in the Gulf of Kekova (Ceramic Gulf), about 49 km east of

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This thesis follows the style and format of the *American Journal of Archaeology*.

<sup>1</sup> Bass 1982, 46-7.

<sup>2</sup> Bass 1982, 45-8.

<sup>3</sup> Bass 1982, 45-8.

<sup>4</sup> Bass 1976, 293.

<sup>5</sup> Bass 1977, 35.

<sup>6</sup> The Turkish spelling of Şeytan Deresi is throughout the text replaced by its English phonetic equivalent, Sheytan Deresi.

Bodrum. There, Cumhuriyet had seen what he had described as two ‘huge jars’ several years earlier.<sup>7</sup>

During the very first dive in the area, Cumhuriyet led the team to the site of the jars, about 100 m southwest of the southeastern-most point of the bay.<sup>8</sup> The site was located at the sandy base of a sloping field of rock outcrops, at a depth averaging 33 m.<sup>9</sup> The only complete ceramic vessels visible, each half-buried in sand, were a krater SD 9 and a two-handled pithos SD 10.



Fig.1. Map of Ceramic Gulf showing the Sheytan Deresi site

<sup>7</sup> Bass 1975, 217-9.

<sup>8</sup> Bass 1976, 293.

<sup>9</sup> Bass 1976, 293.

A few sherds were discovered upon further examination, both lying on the sandy base and on the rocky slope just to the east. Two of these sherds later joined together to form most of the smaller vessel SD 1.

The distribution of the sherds suggested at the time that a foundered ship may have settled in part on the rocky outcrops, but also in part on the sand, allowing for speculations that hull remains could have been preserved under the thick sediment layer. Although no such hull remains were found, the location of the site off the eastern point of an open bay, as well as the uniform fabric of the main ceramic assemblage and their distribution on the seafloor indicated that the finds represented a shipwreck.<sup>10</sup> The next morning three two-man teams, after plotting the position of the finds on the seabed and photographing the site, raised the intact ceramics and dispersed sherds for dating purposes and to protect them from possible looters. The position of the vessels was marked with lead diving weights, buried in the sediment.<sup>11</sup>

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<sup>10</sup> Margariti 1998a, 371.

<sup>11</sup> Bass 1977, 35; Bass 1976, 293.

## CHAPTER II

### THE EXCAVATION

In the summer of 1974 an expedition was planned to return to Sheytan Deresi with the goal of excavating the site discovered the previous year. The war in Cyprus that broke out at the time did not allow for these plans to go forward. Excavation of the site, however, did take place the following year, between September 3<sup>rd</sup> and October 14<sup>th</sup>, 1975.<sup>12</sup>

The expedition team of the (American) Institute of Nautical Archaeology, supported by the National Geographic Society, was led by George F. Bass, and included Cynthia J. Eiseman, Donald A. Frey, Robin C.M. Piercy, Ann S. Bass, Suzanne Biehl, John Cassils, Gay Piercy and Donald Keith, as well as seven students, one of whom was Cemal Pulak, Chair of this Thesis Committee. Oğuz Alpözen represented the Turkish General Directorate of Antiquities, assisted by Yüksel Eğdemir of the İzmir Museum.<sup>13</sup>

The site appeared to be untouched since 1973, with the only features visible being two un-eroded depressions, each marking with a lead weight the position of the ceramic vessels raised two years earlier. INA's 50-ft wooden barge was soon anchored directly over the site and supported two high-pressure and two low-pressure compressors, high-

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<sup>12</sup> Bass 1976, 294.

<sup>13</sup> Bass 1984, 85.



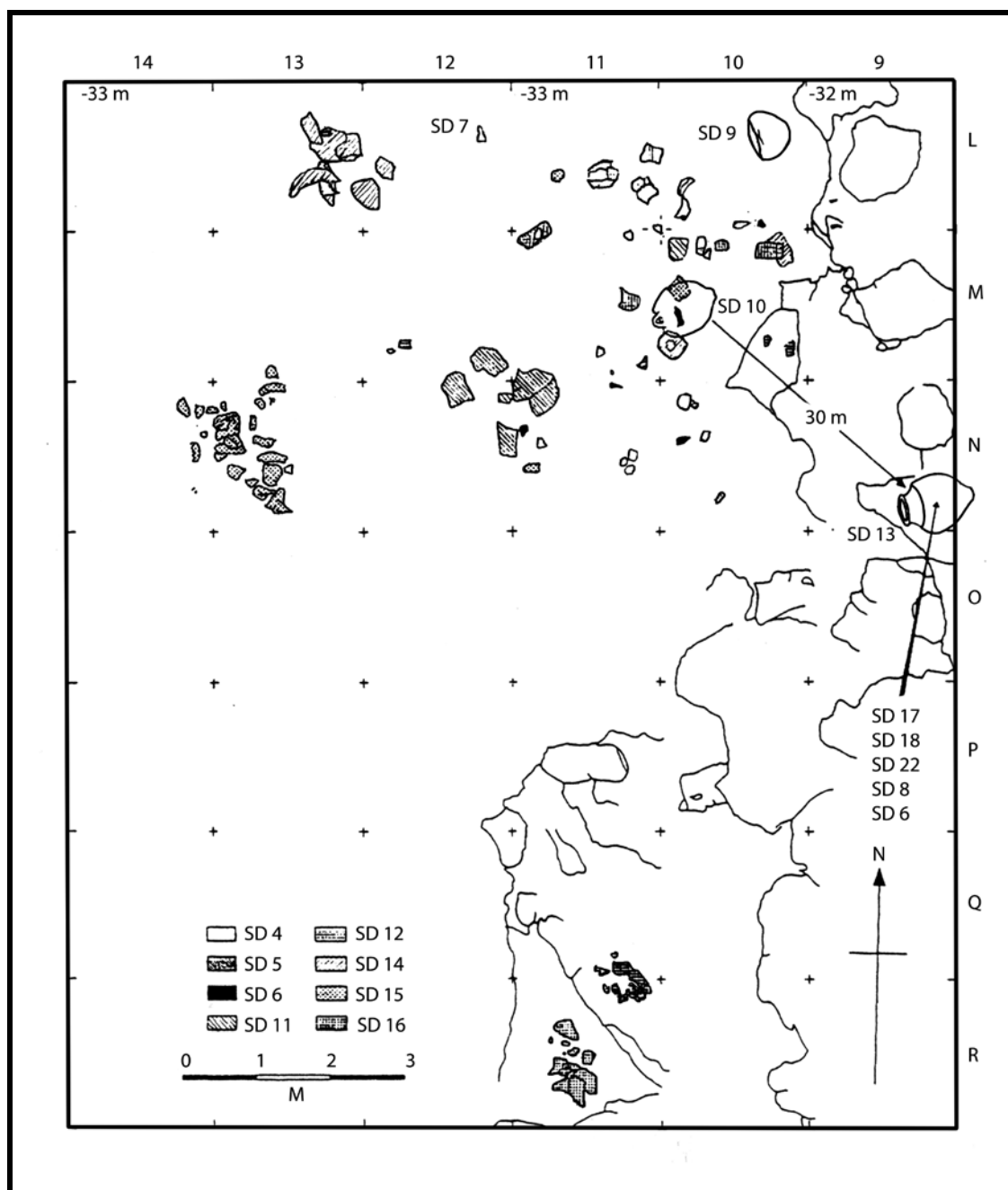


Fig. 2. Excavation site plan (after Bass 1976, 297)

and low-pressure air banks, a double-lock recompression chamber, and all the necessary dive equipment.<sup>14</sup>

A 'telephone' booth was lowered near the base of the rocky outcrop to provide a safety mechanism for divers, while a PVC grid was placed over the area where the survey finds had been located. As the excavation proceeded, a more rigid, expandable metal grid was lowered onto the site, allowing for the addition of bolted squares in a number of directions. While airlifting continued through the use of two PVC pipes, 30 cm-long steel probes were carefully driven into the seabed to search for concentrations of pottery.<sup>15</sup> Any sherds that were discovered were drawn on drafting film and were numbered with crayon so that, once raised, they could be identified before being permanently labeled. Photographs of the seabed taken from above the grid provided a check on the sketches, but no three-dimensional site plan was attempted since minimal vertical profiling would only serve to demonstrate superimposition of sherds, a feature that was already evident in the drawings.<sup>16</sup>

Land-based work including drafting of the site-plan and preliminary cleaning, mending, and cataloguing of pottery, was undertaken within a workhouse constructed in a nearby camp, which also included a temporary dark room.<sup>17</sup>

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<sup>14</sup> Bass 1984, 85.

<sup>15</sup> Bass 1976, 295.

<sup>16</sup> Bass 1976, 295.

<sup>17</sup> Bass 1984, 87.

Most isolated concentrations of sherds represented single vessels that appeared to have probably smashed on impact with the seabed (fig. 2).<sup>18</sup> Curiously, however, while mending the pottery it was discovered that in the midst of such concentrations, one or two sherds would be found that originated from vessels whose fragments lay at some distance. Sometimes concentrations were separated by rock outcrops, precluding movement by currents. These sherds were also usually deeply buried in sand, more than likely precluding their movement in modern times by visitors to the site.<sup>19</sup> At the same time, other than SD 9 and SD 10, both raised in 1973, only one additional complete vessel was recovered, pithos SD 13. It was found lying nearly 30 m away from the main site, on the rocky slope above. Inside archaeologists found a small lead fishline weight of unknown provenience (SD 22), amphora neck SD 18, amphora base SD 17, and two sherds that formed part of amphorae SD 6 and SD 8, the first of which joined perfectly with a sherd from the main SD 6 concentration. In addition, what may be a number of smooth ballast stones were also found within SD 13.<sup>20</sup> It is likely that the SD 6 fragment, along with the other artifacts, was carried into pithos SD 13 by an octopus.

While a number of sherds found in 1973 were on the rocky slope overlooking the site, only one additional sherd was discovered on the rocks during the 1975 excavation, even though teams of six divers swam lanes in close formation covering the seabed for nearly

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<sup>18</sup> The site plan visible in fig. 2 is a reduced and simplified version of the original detailed master site plan, which unfortunately now appears to be lost. Cemal Pulak and Sinda Mandalinci assisted Netia Piercy in the production of the original master plan; Margariti 1998b, 63. Note that not visible in fig. 2 are the reported ballast stones, and the additional ceramic finds discovered in shallower water.

<sup>19</sup> Bass 1976, 297.

<sup>20</sup> Bass 1976, 295.

100 m from the grid in each direction.<sup>21</sup> This sole sherd was the base of amphora SD 6 and was nearly invisible under heavy encrustation. On this note, the director of the excavation commented “it seems unrealistic to believe that, by chance and in haste, we had picked up every sherd loose on the rocks during our few dives in 1973.”<sup>22</sup> Bass continued by raising the question of whether the site had been visited by looters during the interim, as there were few joins discovered among the 1973 sherds, while most objects excavated in the sand in 1975 could be reassembled more or less completely.<sup>23</sup> This latter point also suggests that the site was thoroughly excavated, as the sand was airlifted to bedrock over the entire gridded area (far deeper than the layer which included the ceramics), and was probed for great distances around the main assemblage. The slope was searched to a depth of 50 m,<sup>24</sup> while at the same time a team discovered large sherds and a handle identical to that of pithos SD 10 heavily concreted to the rocky bottom in a shallow area (2 or 3 meters deep) near the coastline, about 100 m from the main site.<sup>25</sup>

In total, the expedition team conducted approximately 550 individual dives, and spent about 310 dive-hours on the site which by the end of the season spread over 42 m<sup>2</sup>.<sup>26</sup> The majority of the dives were undertaken with SCUBA tanks although hookah, or surface-supplied air, was used increasingly towards the end of the project.<sup>27</sup>

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<sup>21</sup> Bass 1976, 295.

<sup>22</sup> Bass 1976, 295.

<sup>23</sup> Bass 1976, 295.

<sup>24</sup> Bass 1976, 295.

<sup>25</sup> Bass 1976, 295.

<sup>26</sup> Bass 1976, 294.

Table 1. List of Main Artifact Assemblage

SAMPLE	DESCRIPTION	CONDITION
SD 1	Amphoriskos	Near Complete
SD 2	Amphoriskos	Fragmentary
SD 3	Amphoriskos	Fragmentary
SD 4	Small Jug	Somewhat Complete
SD 5	Small Jug	Somewhat Complete
SD 6	Piriform Amphora	Near Complete
SD 7	Piriform Amphora	Fragmentary
SD 8	Piriform Amphora	Fragmentary
SD 9	Krater	Complete
SD 10	Strap-handled Pithos	Complete
SD 11	Strap-handled Pithos	Complete
SD 12	Strap-handled Pithos	Complete
SD 13	Handleless ovoid-conical Pithos	Complete
SD 14	Handleless ovoid-conical Pithos	Fragmentary
SD 15	Handleless ovoid-conical Pithos	Fragmentary
SD 16	Handleless ovoid-conical Pithos	Fragmentary

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<sup>27</sup> Bass 1976, 294.

Table 2. List of Intrusive Artifacts

SAMPLE	DESCRIPTION	CONDITION
SD 17	Ceramic pointed base	Fragmentary
SD 18	Amphora shoulder/neck	Fragmentary
SD 19	Amphora shoulder/neck	Fragmentary
SD 20	Amphora shoulder/neck	Fragmentary
SD 21	Amphora body	Fragmentary
SD 22	Lead fishing weight	Complete
SD 23	Amphora neck	Fragmentary
SD 24	Ceramic base and body	Fragmentary

### CHAPTER III

#### SUMMARY OF THE FINDS

Seen as a whole, the finds seem to represent an appropriate cargo for a small seagoing vessel. Artifacts recovered and belonging to the main assemblage include the remains of 16 ceramic vessels, ten of which could be restored to their original, complete profiles (table 1). The ceramics can be attributed to one of six main types (fig. 3). Among them, and in varying degrees of completion, are three handleless pithoi, with fragments of a fourth; two slightly smaller strap-handled pithoi, with fragments of a third; a large krater; three piriform amphorae; one complete and two fragmentary amphoriskoi; as well as two, one-handled jugs. Additional ceramic fragments were also recovered. All of the ceramics are made of similar dark reddish-brown, gritty clay. Most of them are irregularly or crudely fashioned with rarely discernible wheel marks. Interior surfaces are often uneven, with hand impressions. The pithoi were made in several sections; their flat bases seem to have been formed as separate clay discs as, like those of the amphorae, they have splayed slightly from the weight of their bodies attached before firing. Handle attachments of the pithoi and krater were strengthened by a finger being thrust through the body wall into each handle base, leaving a deep cavity. Being coarse, utilitarian vessels, the main assemblage of pottery may have served as merchandise containers and/or constituted local trade items themselves, while some may have held the crew's food and drink supply.

In addition, several easily discernible intrusive ceramic fragments were recovered from around the site, made of various clays and none with joins to other fragments (table 2). Basketfuls of smooth stones not visible on the site plan, possibly ballast, were recovered from among the pottery scatter in the sandy area of the site, as well as from within pithos SD 13 noted above.<sup>28</sup> These can unfortunately no longer be located.

There were no other finds, however, like those normally associated with ancient wrecks – lamps, weights, cooking wares, tools, weapons, etc. Nor were there any hull remains located, even though the sand was deep enough to have preserved wood. This discrepancy in the finds poses the question whether the vessel carrying the ceramic assemblage actually foundered along with part of its cargo, or rather capsized, spilling its cargo, and then possibly recovered or was tossed by the wind and waves onto the rocky coast. The possibility of whether the cargo was deliberately jettisoned in time of danger also requires further examination.

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<sup>28</sup> Bass 1976, 296.



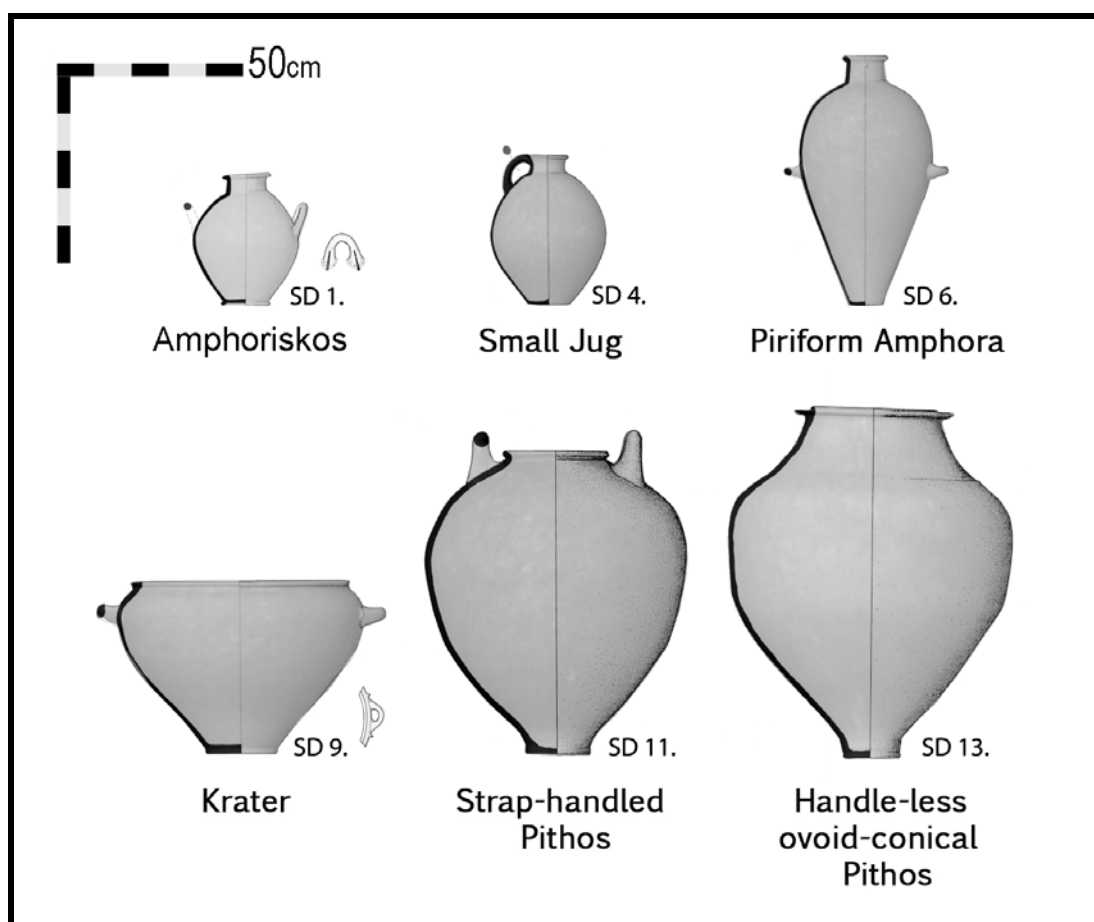


Fig. 3-Dimensional illustrations of the SD ceramic types

## CHAPTER IV

### THE MAIN CERAMIC ASSEMBLAGE<sup>29</sup>

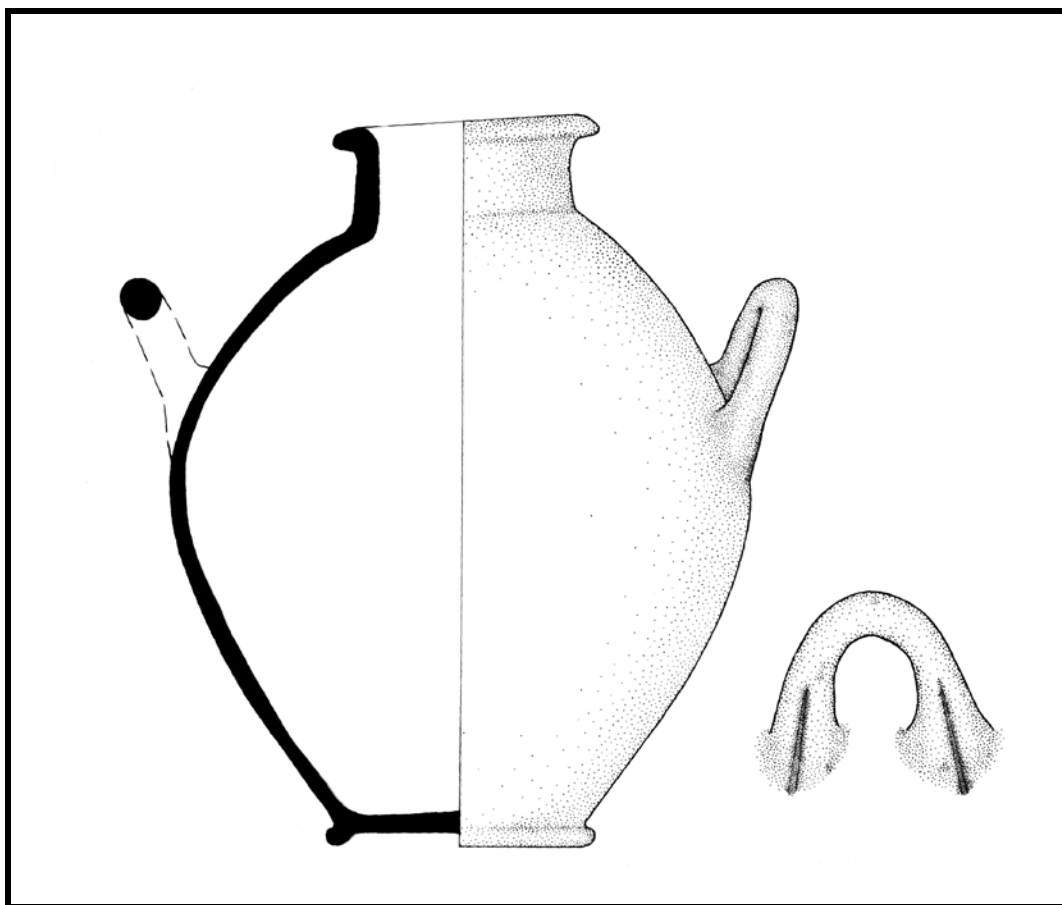


Fig.4. Amphoriskos SD 1

<sup>29</sup> The dimensions given for both the main assemblage and intrusive material originate from the measurements taken by the excavation team. Although they present a more complete record than those found in Margariti (1998), there are discrepancies between the two records. Given the current state of disassembly of the artifacts, which are undergoing further conservation, original measurements could not be taken. At the same time, archaeological drawings are not available for all of the ceramics, nor are they all to today's desired standard, but have nevertheless been included in order to illustrate the artifact descriptions. Scales have not been added after the fact by the author as they would only be approximations and may therefore be misleading. Descriptions draw information from a number of sources including Bass (1976), Margariti (1998), entries in the field notebooks and artifact catalogues, as well as personal observations by the author. Munsell color chart designations are presented where available.

SD 1 (fig. 4) – Amphoriskos

Survey Designation: Items N and J.

Dimensions: H: 0.357 m, Max. D: 0.280 m, Mouth D: 0.129 m, Base D: 0.130 m.

Description: Near complete amphoriskos, composed of two large fragments with part of one side missing, along with one handle. The underside of the rim is chipped. The vessel is moderately encrusted on both the interior and exterior surfaces, and is also stained darker in areas along the exterior surface. It is made of reddish-brown coarse fabric (2.5YR 4/4 to 2.5 YR 3/4), heavily pitted and with white grit. There are no signs of wheel marks and the vessel is irregularly constructed, exhibiting deep holes up to 4 mm in diameter. The vessel is supported by a low ring base which extends into an ovoid body where the maximum diameter is at half the maximum height. A slightly concave neck terminates in an overhanging splaying lip. The preserved up-swinging horizontal loop-handle, circular to oval in section, attaches to the body just above the maximum diameter. On the exterior of the handle, c. 5 cm long pre-firing incisions extend deeply from either base upward. Two short deep cuts appear beside the incisions. Three very shallow horizontal grooves are visible; the lowest is located 1 cm below the bottom of handle base, the middle one just at bottom of handle base, and the topmost at the center of handle base. A fragment is missing on the side opposite the existing handle where its pair would most likely have been located. Two similar grooves 1 cm apart set off a slightly convex ridge on top of the shoulder, just below the juncture with the neck. A third, barely perceptible groove is located 1.5 cm below these.

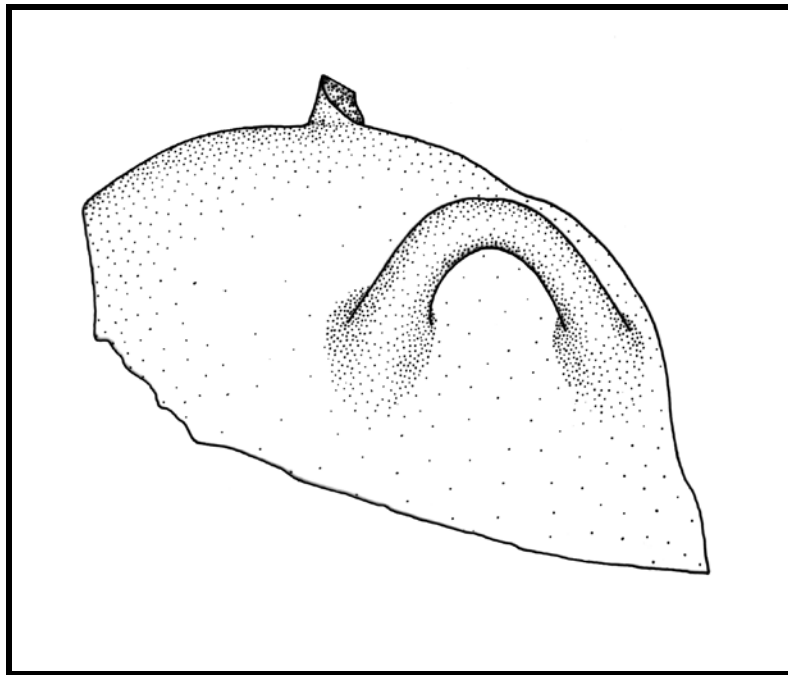


Fig.5. Amphoriskos fragment SD 2

SD 2 (fig. 5) – Amphoriskos Fragment

Survey Designation: Item K.

Dimensions: Pres. H: c.0.180 m, Th: 0.005-0.007 m.

Description: Originally a single amphoriskos fragment with a horizontal loop-handle. It is moderately encrusted on both the interior and exterior surfaces. It is made of reddish-brown fabric, pitted, with white grit. No wheel-marks are visible on either surface and the sherd is now in two pieces. It is similar in shape to SD 1 except for its thinner fabric and that it probably belongs to a vessel with a squatter body. The handle is also smaller than the handle present on SD 1 and is probably placed less vertical following a more irregular curve. Noteworthy is the lack of cuts along the exterior face of the handle. No grooves are visible.

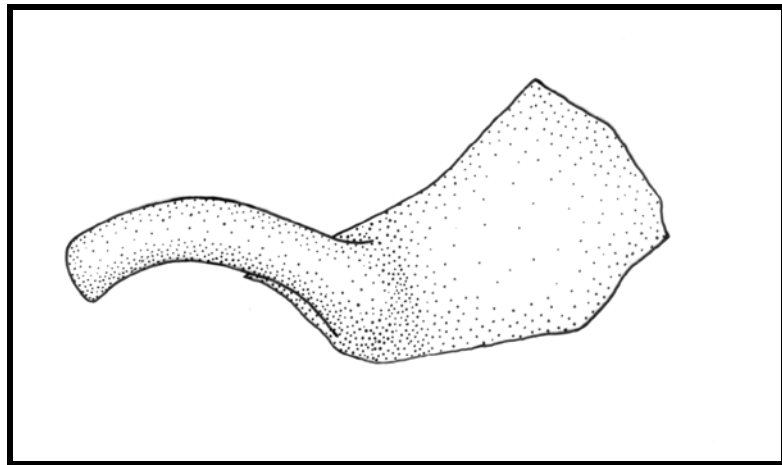


Fig.6. Amphoriskos fragment SD 3

#### SD 3 (fig. 6) – Amphoriskos Fragment

Excavation Designation: DC 114.

Dimensions: Handle D: 0.02 m attached to body fragment 0.108 x 0.069 m; Th: 0.004 m.

Description: Handle fragment and body fragment most likely belonging to an amphoriskos, similar to SD 1 and SD 2. It is moderately encrusted on both the interior and exterior surfaces. No wheel marks are visible. It is made of brownish buff fabric, finer than that of SD 1 and SD 2 but with similar white grit. Partial handle appears more horizontal than those of SD 1 and SD 2, and with a smaller loop. No cuts are present on the exterior face of the handle. No grooves are visible.

#### SD 4 (fig. 7) – Small Jug

Consists of: Excavation fragments 12, 20, 24, 146, two pieces from L/M 10, one unidentified piece.

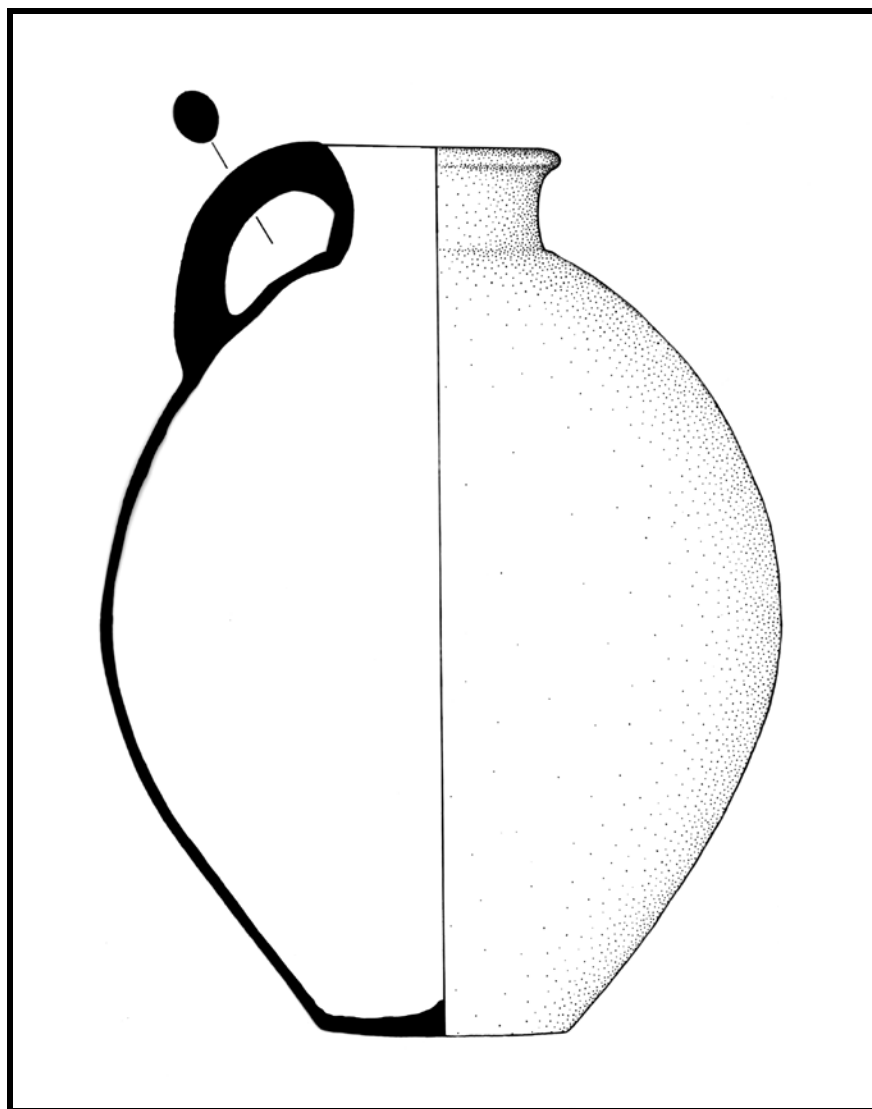


Fig.7. Small jug SD 4

Dimensions: H: 0.402 m, Max. D: 0.316 m, Mouth D: 0.113 m, Base D: 0.125 m.

Description: Partially complete small jug consisting of seven fragments that make up approximately half of the restored vessel. The rim and part of neck is chipped. It is lightly encrusted primarily on the exterior surface, which also carries occasional darker-stained areas. No wheel marks are visible. It is made of very coarse reddish-brown fabric

(2.5YR 3/4 to 2.5 YR 4/6), heavily pitted, with white grit. The piriform body rises from a very uneven plain flat base, to a maximum diameter of 20 cm. The mid-section of the vessel is asymmetrical, possibly due to missing fragments.<sup>30</sup> The slightly concave neck ends in a rolled rim that appears more rounded than that of SD 1. A single vertical handle, oval in section, rises from shoulder to attach to the rim and neck, with the top of the handle extending slightly above the rim.

#### SD 5 (fig. 8) – Small Jug

Consists of: Excavation fragments 44, 124, 131, 147, 3 from L/M 10, unidentified neck; Survey Item M (base).

Dimensions: H: 0.395 m, Max. D: 0.315 m, Mouth D: 0.121 m, Base D: 0.122 m.

Description: Near complete small jug consisting of several fragments with a large part of shoulder and a piece of lower body missing. It is lightly encrusted on both the interior and exterior surfaces. No wheel marks are visible. It is made of reddish-brown coarse fabric, pitted, with white grit. The overall body shape is piriform, but the lower part is more rounded than that of SD 4. The slightly concave neck rises to a rolled-over rim. The single vertical handle, oval in section, rises from shoulder to attach to rim and neck. The handle has been smoothed onto the rim, making the highest part of the handle slightly proud of the rim. There is a pronounced irregular groove at the juncture of the neck and body.

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<sup>30</sup> Margariti 1998b, 20.

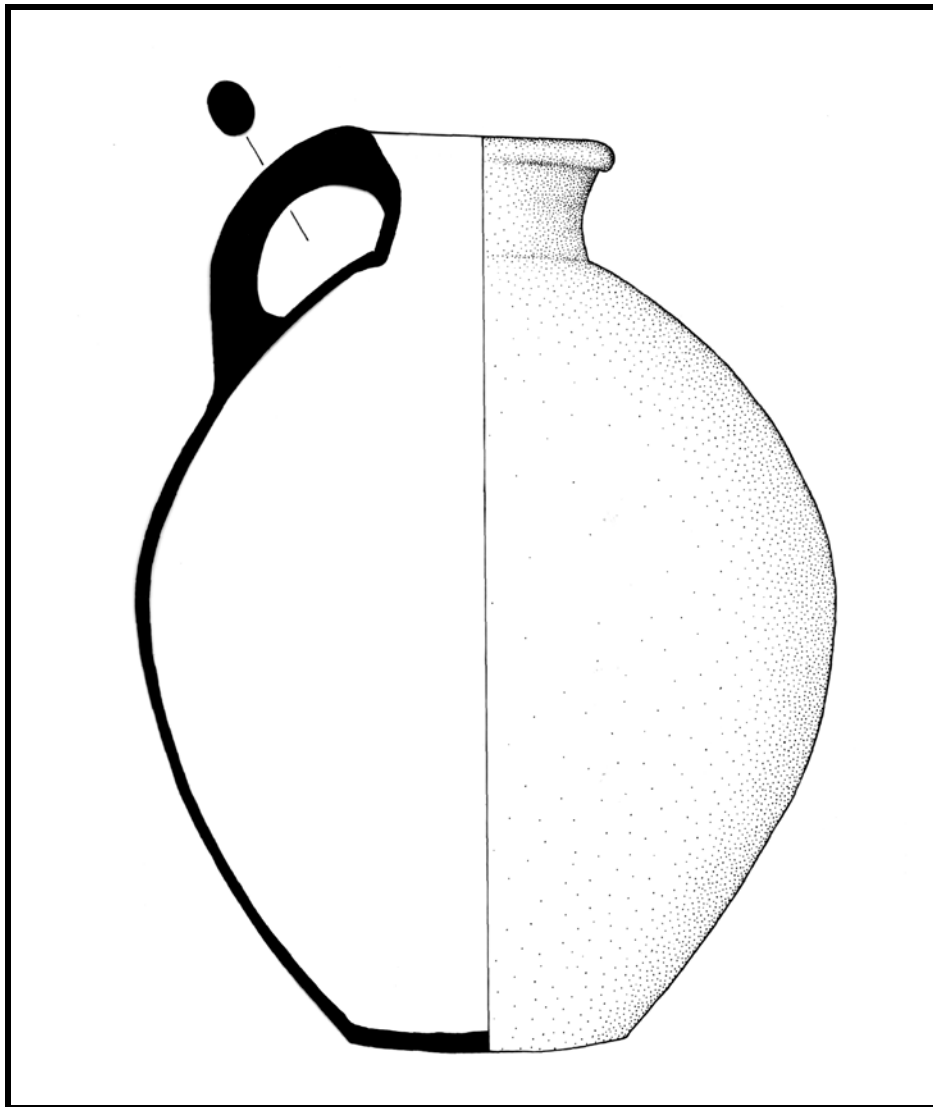


Fig.8. Small jug SD 5



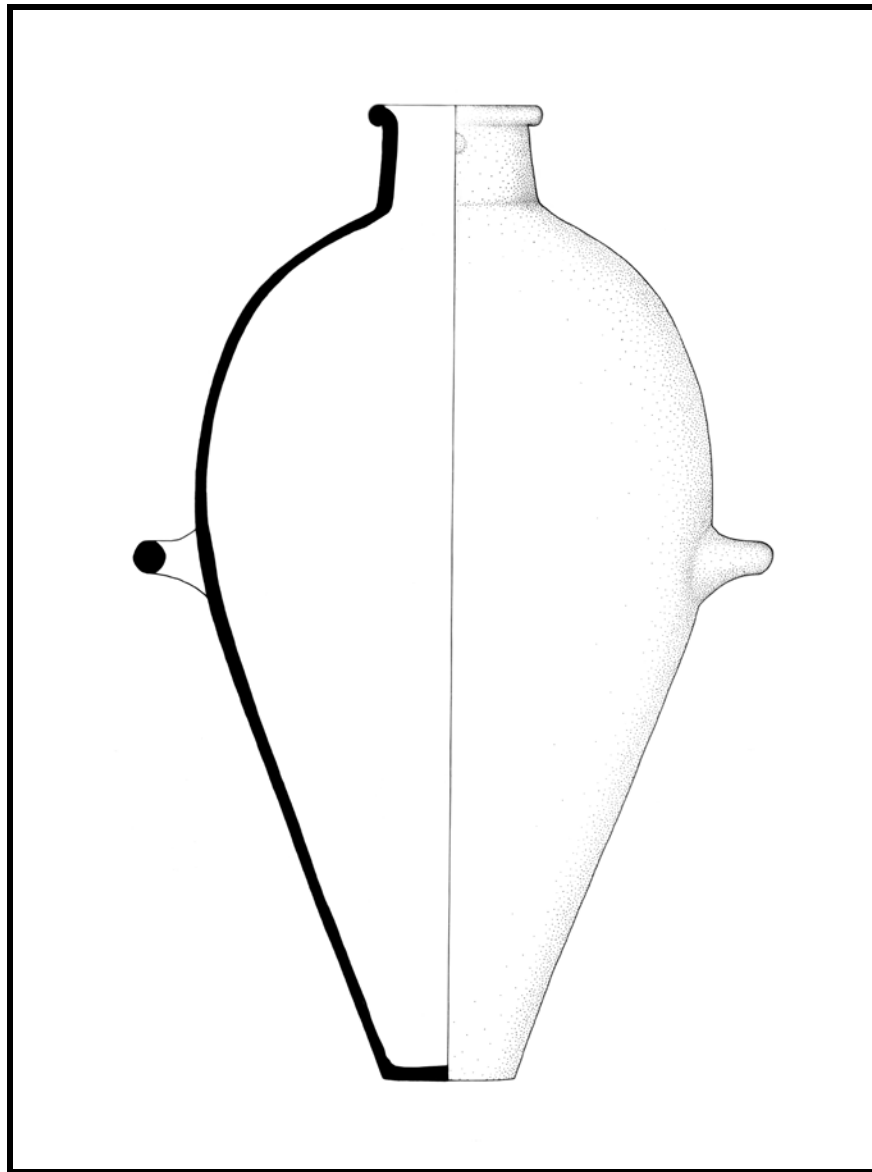


Fig.9. Piriform amphora SD 6

SD 6 (fig. 9) – Piriform Amphora

Consists of: Excavation fragments 25, 117, 143; Survey Items E (neck) and I (body).

Dimensions: H: 0.674 m, Max. D: 0.353 m, Mouth D: 0.120 m, Rim D: 0.117, Base D: 0.0950 m.

Description: Near-complete piriform amphora consisting of more than five fragments, with parts of the main body and shoulder missing. It is lightly encrusted on both the interior and exterior surfaces. It is made of varying shades of dark brown to reddish brown coarse fabric (2.5YR 4/2 to 2.5YR 4/6), pitted, with white grit. A modern break on the base reveals the core of the fabric to be pinkish red (no Munsell color designation recorded). There are no wheel marks visible. The elongated ovoid-conical body rises from the narrow flat base in a very slight convex curve to a tapering neck with a thick rounded rolled-over rim. Two cylindrical horizontal loop-handles, irregular in diameter, are irregularly placed on the body, below the vessel's maximum diameter. An applied plastic button or knob, 1.5 cm in diameter, is centrally located along the vertical axis between the handles on the top of neck and may have served a practical function for somehow securing a stopper, or may have been purely decorative. No stamp is present.

#### SD 7 (fig. 10) – Piriform Amphora

Consists of: Excavation fragment 22 (neck), one piece of L/M 10; Survey Item H.

Dimensions: Pres. H: 0.630 m, Max. D: 0.359 m, Th: 0.01 m to 0.105 m.

Description: Fragmentary piriform amphora consisting of three main pieces with the lower third of the body, the base, and part of the neck missing. It is lightly encrusted on both the interior and exterior surfaces. It is made of dark brown to reddish-brown coarse fabric, pitted, with white grit. There are no wheel marks visible. The shape is similar to that of SD 6, including the applied plastic button centrally located at the top of the neck (not visible on drawing). No stamp is present.

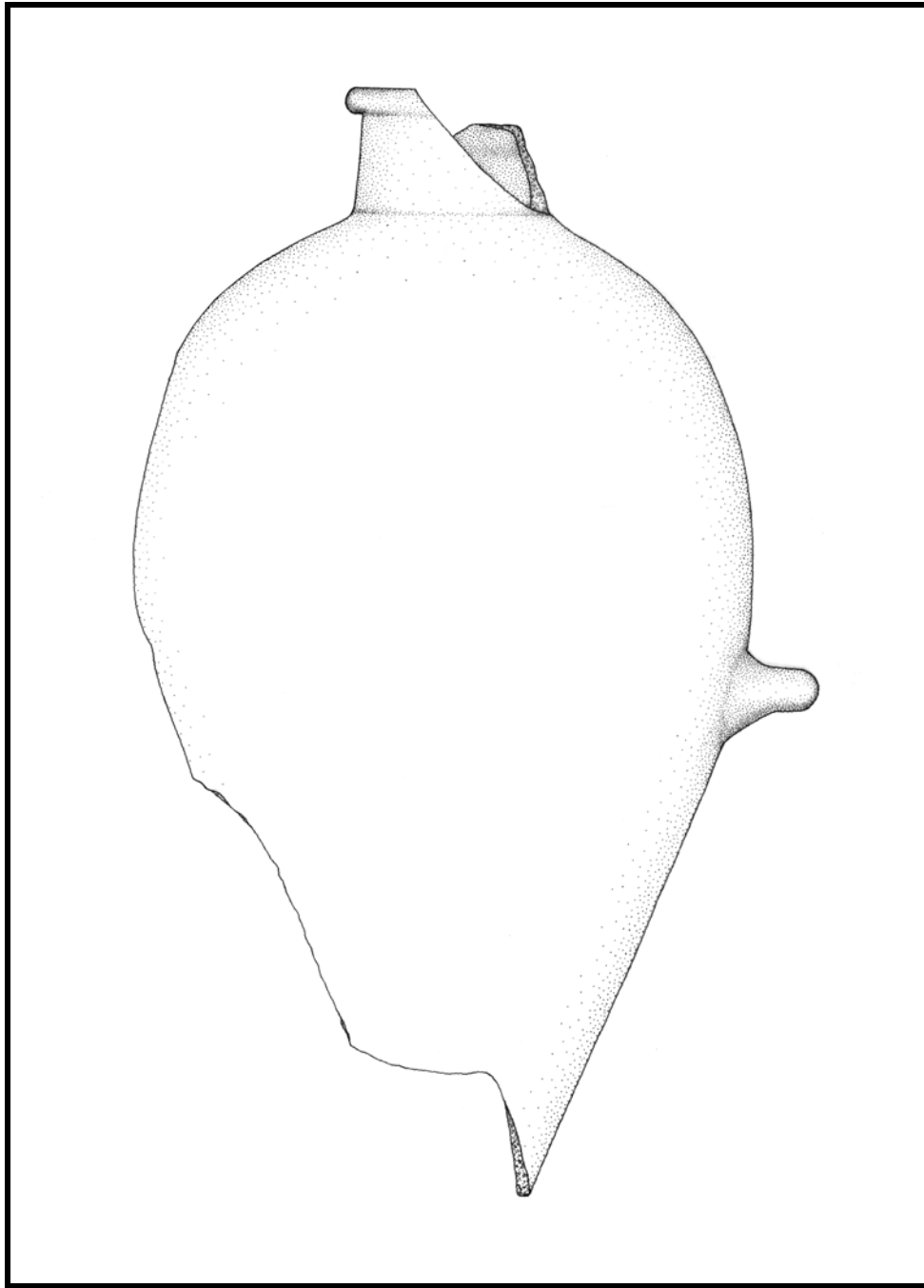


Fig.10. Piriform amphora SD 7

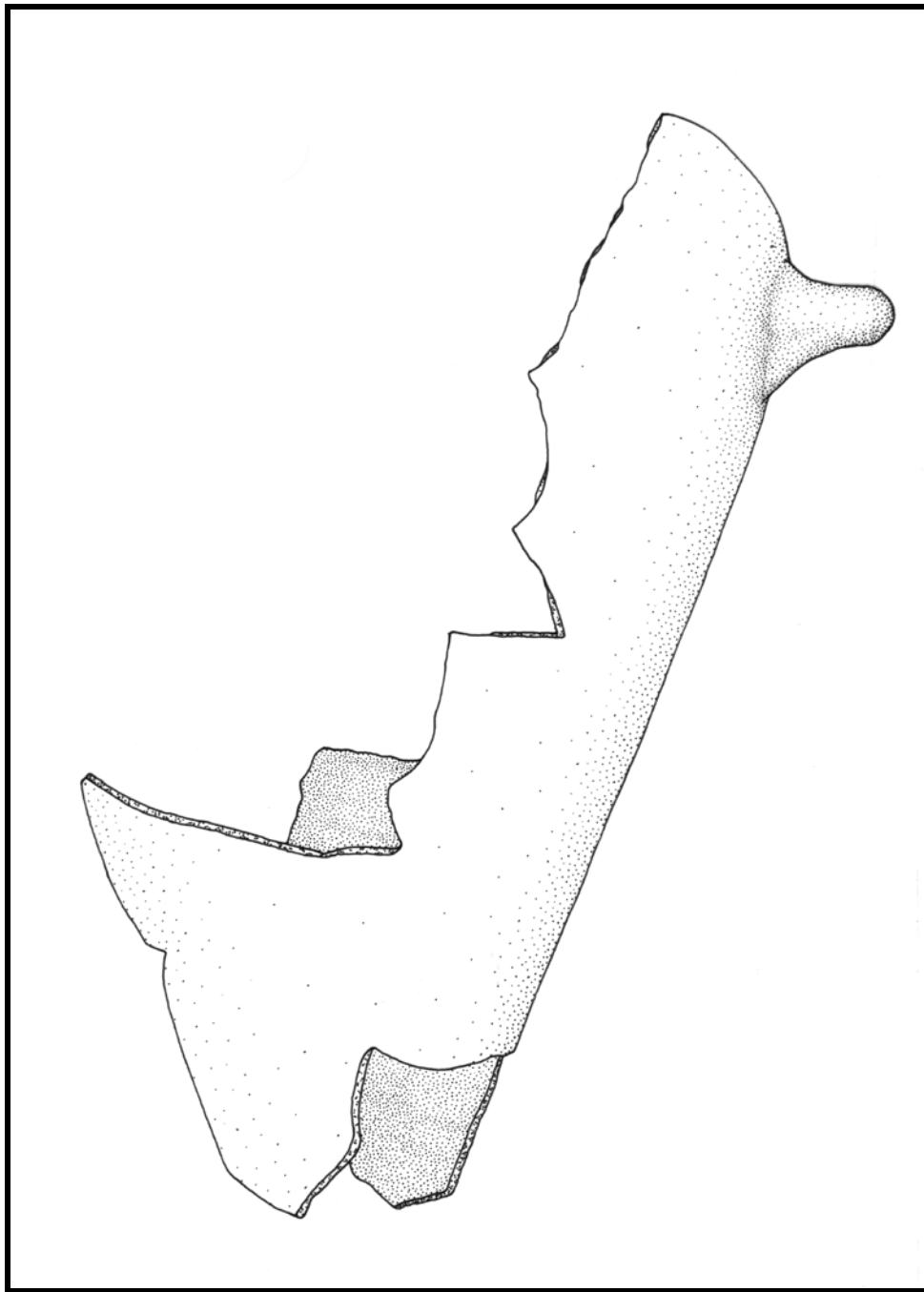


Fig.11. Piriform amphora SD 8

Artifact SD 8 (fig. 11) – Piriform Amphora

Consists of: Excavation Fragment 110, two pieces of L/M 10, one unidentified piece;  
Survey Item L.

Dimensions: Pres. H: 0.460 m, Th: 0.01 m.

Description: Partial piriform amphora consisting of five pieces, comprising of approximately half of the body and a handle. It is slightly encrusted on both the interior and the exterior faces. It is made of dark brown to reddish-brown fabric, pitted, with white grit, similar to SD 6 and SD 7, but thicker. There are no wheel marks visible. The shape follows that of SD 6 and SD 7 but it is poorly preserved.

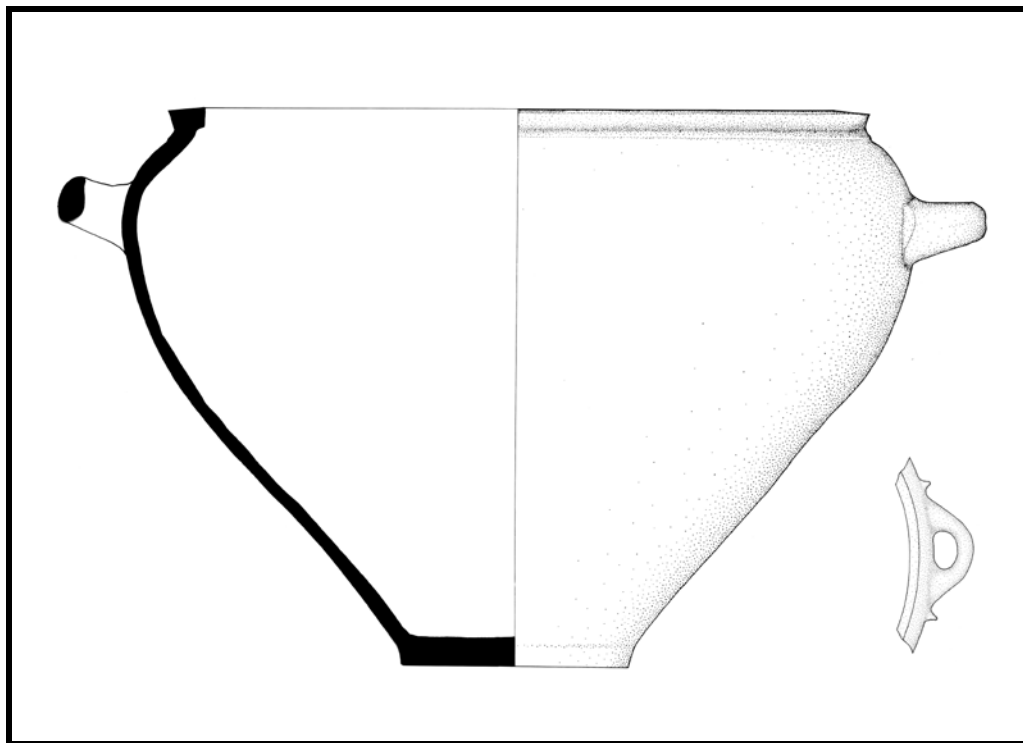


Fig.12. Krater SD 9

SD 9 (fig. 12) – Krater

Survey Designation: Item C.

Dimensions: H: 0.470 m, Max D: 0.652, Rim D: 0.580 - 0.600 m, Mouth D: 0.515, Base D: 0.191 m.

Description: Complete conical large krater representing the only open vessel of the main assemblage. It is moderately encrusted on both the interior and the exterior faces, with only minor chips on the rim. The fabric is coarse, reddish-brown (2.5YR 3/4 to 2.5 YR 4/6), pitted, with white grit. The surface is smooth in some places, but rougher where the surface has been exfoliated. The thickness of the fabric varies considerably with horizontal undulating steps along the interior surface, which are not present on the exterior. This may suggest a layering method of construction. The somewhat uneven flat base appears to have been added as a disc to the round opening in the bottom of the vessel. In turn, the bottom splays out slightly, and then rises in a soft concave, then convex curve to the vessel's maximum diameter at the shoulder. The plain rim is set off from the shoulder by a narrow ridge running in low relief along the circumference. Two horizontal loop handles are attached along the shoulder, curving upwards to a small degree along the vessel's maximum diameter. At either end of the handles, where they attach to the body, one can observe pointed clay protuberances, which appear to have been applied or formed separately from the handles. Deep depressions go through the interior walls of the body into all four handle attachments. Rough decorative horizontal lines appear on the exterior surface, while the exterior shoulder area shows possible wheel marks.

## SD 10 - Strap-handled Pithos

Survey Designation: Item B.

Dimensions: H: 0.90 m, Body H. 0.84 m, Max D: 0.706 m, Base D: 0.155 m, Rim D: 0.321 m, Handle H. 0.130 m.

Description: Complete piriform-ovoid, strap-handled pithos, with only minor chips on the rim. It is moderately encrusted on both the interior and exterior surfaces. It is made of reddish-brown to brown (2.5 YR 4/4 to 2.5 YR 3/4) coarse fabric, pitted, with white grit, and the smoothed surface has eroded to a large degree. The plain flat base extends into a funnel-shaped lower body, with the upper body bulging out as if attached separately. The vessel continues from the shoulder directly to a thick flaring rim, as there is no neck. Two nearly vertical loop or strap handles are horizontally-attached to the upper part of the shoulder. They are sturdily made, nearly round in section, and one carries a depression on its top side. The other handle has a deep cut not far above the handle attachment. Deep depressions go through the interior walls of the body into all four handle attachments. Both handles project above the rim of the vessel allowing for the possibility of a rope or pole, no more than 3 cm in diameter, to be inserted through them in order to facilitate lifting.<sup>31</sup> One of the handles exhibits two cuts different in arrangement but similar in depth of incision to those present on amphoriskos (SD1).<sup>32</sup> A very narrow ridge in low relief runs along the circumference of the vessel below the rim. The interior undulates in thickness with one thick heavy ridge present in the lower body.

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<sup>31</sup> Margariti 1998b, 34.

<sup>32</sup> Margariti 1998b, 34

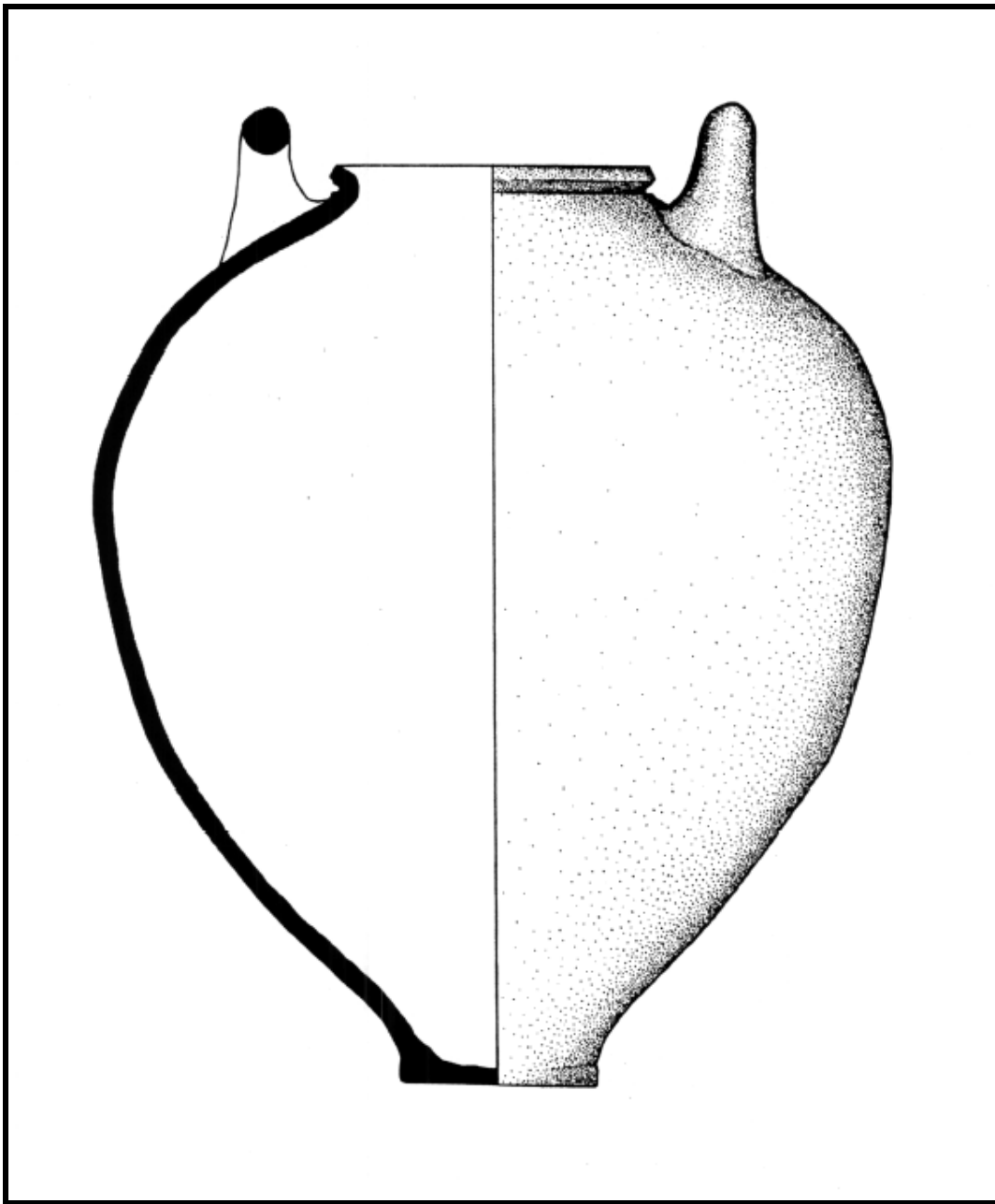


Fig.13. Strap-handled pithos SD 11



### Artifact SD 11 (fig. 13) – Strap-handled Pithos

Consists of: Excavation fragments 1, 2, 3, 5, 6, 7, 8, 13, 14, 16, 27, 29, five pieces from L/M10, four unidentified pieces.

Dimensions: H: 0.907 m, Body H: 0.858 m, Max D: 0.716 m, Base D: 0.175 m, Rim D: 0.295 m, Mouth D: 0.252 m, Handle H: 0.130 m.

Description: Near complete piriform-ovoid, strap-handled pithos, with only a few body sherds missing from the lower body and minor chips on the rim. It is moderately encrusted on both the interior and exterior surfaces and is made of reddish-brown to brown coarse fabric, pitted, with white grit. The smoothed surface is better preserved than that of SD 10 and the overall shape is very similar, including the narrow ridge below the rim, but without the deep cuts above the handle attachments.

### SD 12 - Strap-handled Pithos

Consists of: Excavation fragments 26, 31, 32, 33, 34, 35, 36, 37, 38, 74, 76, 77, 155, 156, 157, and one piece from L/M 10.

Dimensions: Mouth D: c. 0.300 m, Th: 0.010-0.015 m.

Description: Fragmentary piriform-ovoid, strap-handled pithos, with approximately half of the rim preserved, along with a few shoulder fragments and a handle. The fragments were found moderately encrusted on both the interior and exterior surfaces. The coarse fabric is reddish-brown to brown in color, pitted, with white grit. The form is of the same type as those of SD 10 and SD 11 but does not carry the narrow ridge below the rim evident in the other two examples.

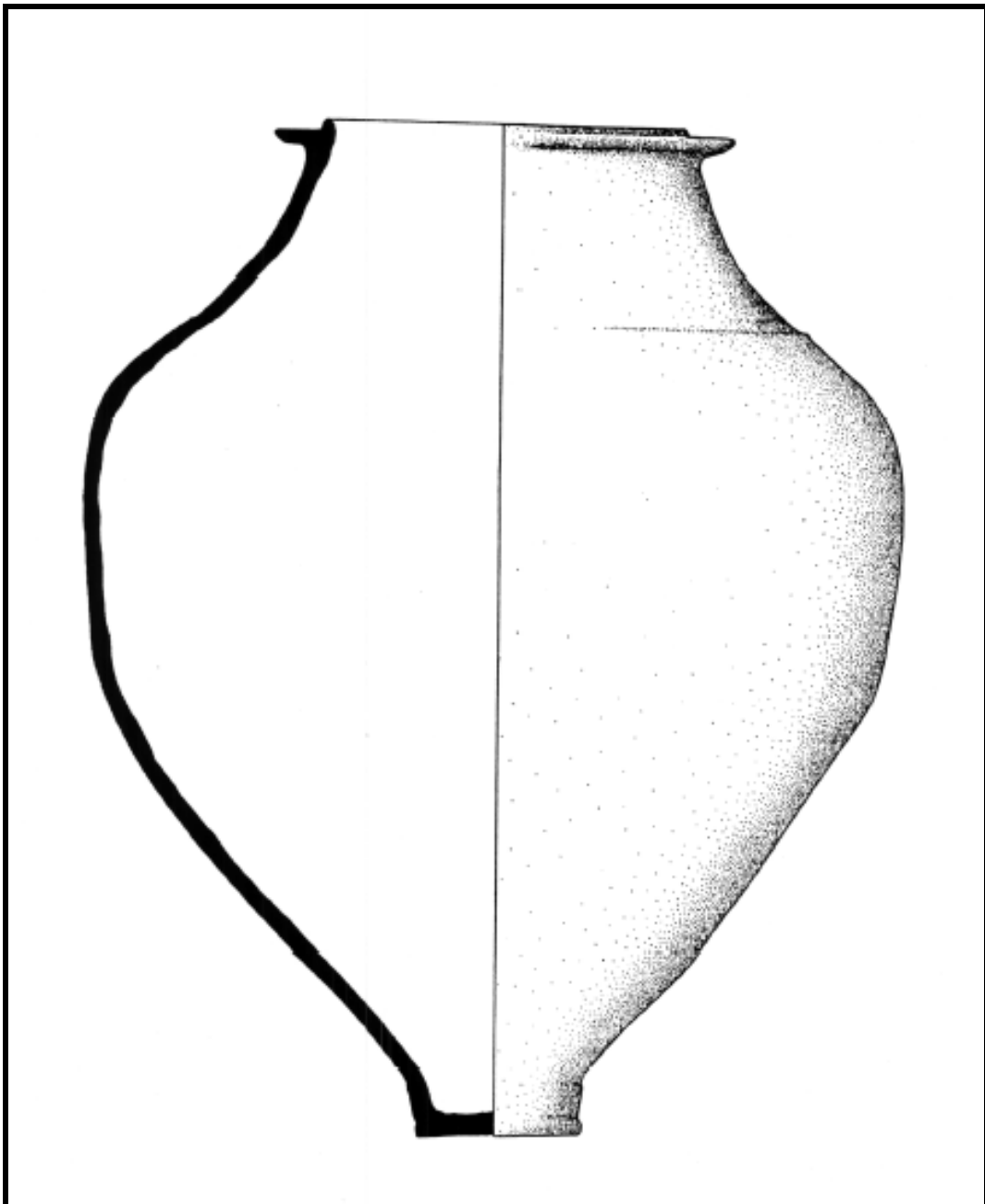


Fig.14. Handleless ovoid-conical pithos SD 13

SD 13 (fig. 14) – Handleless Ovoid-conical Pithos

Excavation Designation: DC 135, found approximately 30 away from main concentration of pottery.

Dimensions: H: 0.987 m, Max D: 0.766 m, Base D: 0.157 m, Mouth D: 0.322 m, Rim D: 0.432 m, Th: 0.011 m.

Description: Near complete ovoid-conical, handleless pithos, found complete, but fractured on the seabed. It was raised in eight pieces to facilitate recovery, but one small piece was lost while transporting the fragments to the surface. The edge of the base is partly worn, with minor chips and erosion on the rim visible. The vessel is moderately encrusted on both interior and exterior surfaces. It is made of reddish brown (2.5YR 4/4 to 2.5 YR 3/4) coarse fabric, pitted, with white grit. The existing surface appears sandy, but this is most likely due to the erosion of an original, occasionally discernible, smoother surface. The plain flat base is slightly wider than the foot, and may also have been formed from a separate disc of clay, attached to the foot prior to firing. The lower body is funnel-shaped and widens to the maximum diameter of the vessel along the upper shoulder. A horizontal ledge on the shoulder forms a step below the neck in the shape of an inverted truncated cone. A break on the ledge reveals that the upper part of the neck was attached separately, and then the ledge was positioned to cover the juncture. The horizontal wide rim extends outwards and carries a raised ridge around the mouth of the vessel. The interior wall of the vessel undulates as fabric thickness varies.

#### SD 14 - Handleless Ovoid-conical Pithos

Consists of: Excavation fragments 9, 10, 11, 17, 19, 21, 42, 78, 151, one piece from L/M 10, one unidentified piece; Survey Item A (rim).

Dimensions: H: 0.909 m, Max D: 0.713 m, Base D: c. 0.145 m, Rim D: 0.408 m, Mouth D: 0.290 m, Th: 0.010- 0.012 m.

Description: Fragmentary ovoid-conical, handleless pithos, composed of 12 fragments with most of the base and a few body sherds missing. The rim is chipped around the inside face of the mouth and part of the base is eroded. The vessel is moderately encrusted on both interior and exterior surfaces. It is made of reddish-brown coarse fabric, pitted, with white grit. The smooth surface on the rim and the area just below it may display wheel marks but similar, often distinct, marks continue down at an oblique angle, suggesting a burnishing of the surface. The overall shape is similar to that of SD 13 with minor differences. A groove can be discerned around the foot of the vessel, about 4 cm above the plain flat base. The body rises following a more fluid curve to the shoulder ledge than that seen on SD 13 and continues to the neck, which is slightly more concave than that of SD 13.

#### SD 15 - Handleless Ovoid-conical Pithos

Dimensions: H: 0.924 m, Max. D: 0.740 m, Rim D: 0.400 m, Mouth D: 0.278 m, Th: 0.010-0.012 m.

Description: Fragmentary ovoid-conical, handleless pithos, with approximately 1/3 of the body, shoulder, base, and rim missing. The present fragments, however, are

sufficient to allow for restoration and identification of the vessel as similar to SD 13 and SD 14. The fragments were found moderately encrusted on both interior and exterior surfaces. They are made of reddish-brown coarse fabric, pitted, with white grit. Although the form of the vessel follows the type demonstrated by SD 13, the lower part of body curves inward sharply, suggesting that whereas the bodies of SD 13 and SD 14 were made in three separate sections, the body of SD 15 may have been made in four.

#### SD 16 - Handleless Ovoid-conical Pithos

Dimensions: Th: 0.010-0.013 m.

Description: Fragmentary ovoid-conical handleless pithos composed of several parts and belonging to the same type as SD 13, SD 14, and SD 15. The fragments were found moderately encrusted on both interior and exterior surfaces and are made of reddish-brown coarse fabric, pitted, with white grit.

## CHAPTER V

### INTRUSIVE MATERIAL

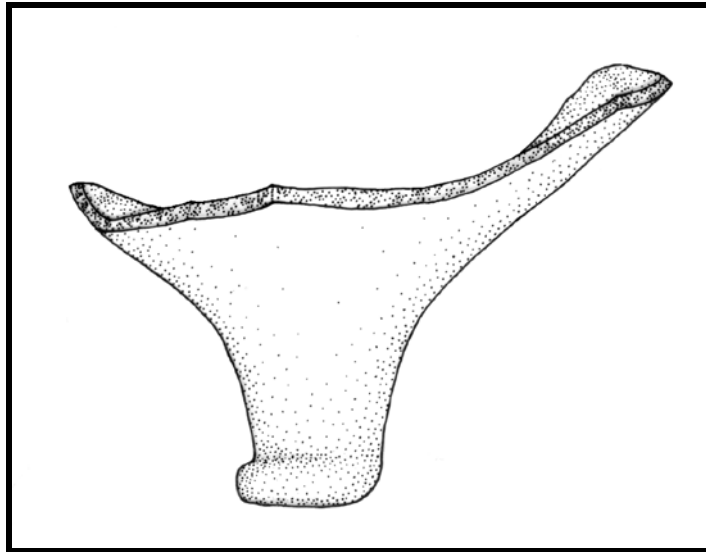


Fig.15. Amphora toe SD 17

SD 17 (fig. 15) – Pointed Base of an Amphora

Excavation Designation: DC 113.

Dimensions: Pres. H: 0.125 m, Base D: 0.045 m.

Description: Base of an amphora with a protruding toe in the shape of a flat disc, eroded and/or broken away on one side. It is attached to an upward splaying stem. There is an uneven depression on one side of the lower body due to some outside pressure during firing. The fragment is made of a brown gritty fabric, unlike that of the main assemblage. The interior demonstrates horizontal ribbing and is extremely uneven. It was found inside pithos SD 13 during the 1975 excavation.

Provenience: Due to its fragmentary and generic nature, SD 17 is of uncertain provenience, although most likely belongs to the Greco-Roman period.

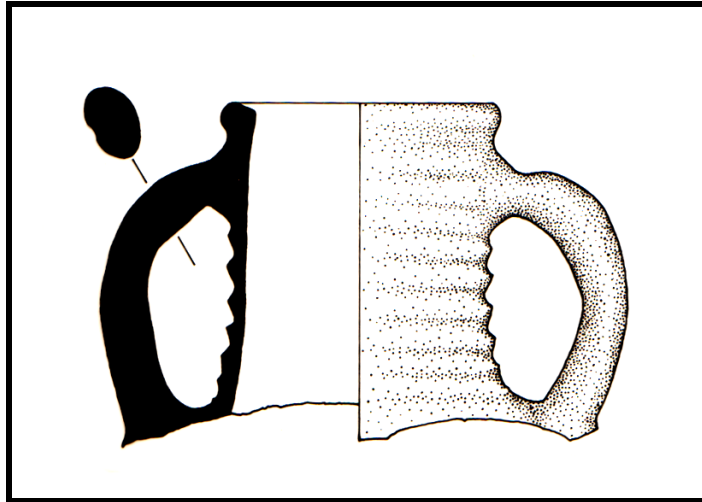


Fig.16. Amphora shoulder/neck SD 18

SD 18 (fig. 16) – Amphora Shoulder/Neck

Excavation Designation: DC 112.

Dimensions: Pres. H: 0.135 m; Mouth D: 0.110 m.

Description: Amphora neck fragment with part of shoulder and two handles preserved.

The fragment is heavily encrusted on both interior and exterior surfaces. It is made of very dark to lighter brown fabric, with a modern chip revealing a lighter brown buff color just beneath the surface. The fabric sets it apart from the main assemblage. The nearly cylindrical neck has eight deep horizontal grooves that are flanked by rather sharp ridges. The somewhat thickened round lip is not pronounced. The oval vertical handles

are nearly flat in section, extending outward from the shoulder before turning in to irregularly join the neck. No stamp or graffiti visible. The fragment was found inside pithos SD 13 during the excavation of the site in 1975.

Provenience: SD 18 resembles a fourth cen. C.E. amphora of unknown provenience present in the Bodrum Museum of Underwater Archaeology collection. It is a type that has been found in the Aegean, Black and Mediterranean Seas.<sup>33</sup>

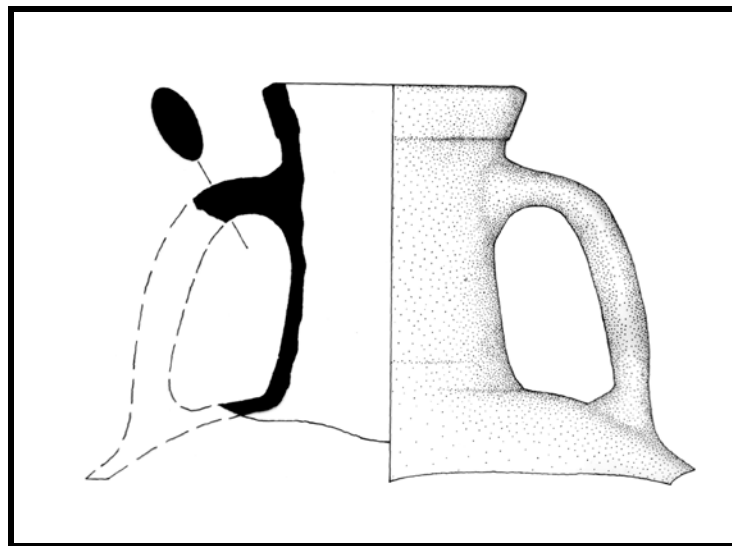


Fig.17. Amphora shoulder/neck SD 19

SD 19 (fig. 17) – Amphora Shoulder/Neck

Survey Designation: Item D.

Dimensions: Pres. H: 0.215 m, Mouth D: 0.150 m.

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<sup>33</sup> Alpözen et al. 1995, 109.



Description: Amphora neck fragment with part of the shoulder, one complete and one partial handle preserved, originally found moderately encrusted on both interior and exterior surfaces. It is made of a fairly fine light brown fabric, dissimilar to that of the main assemblage. The rim is shaped like an inverted truncated cone distinctly set on top of the neck. It projects only slightly from the neck, which continues the outward angle dictated by the rim. The oval vertical handles slope only slightly inwards and are nearly flat in section. A horizontal incision is visible near the bottom of the neck on one side. The interior of neck seems to show evidence of wheel marks, but remains uneven. No stamp or graffiti visible.

Provenience: Bass compares SD 19 to a seventh-century B.C.E. amphora from Chios.<sup>34</sup>

The Chiote vessel bears a general resemblance to the Sheytan Deresi specimen, but has a shorter neck, proportionally wider mouth, and handles that slope more dramatically than those of SD 19. Margariti suggests a further seventh-century example of an amphora neck from Clazomenai, which may constitute a better parallel as regards the angle of the handles.<sup>35</sup> In general, however, amphorae from Clazomenai do not have an outward-angled neck until the end of the sixth century B.C.E.<sup>36</sup> The worn horizontal incision near the bottom of the neck could indicate a Milesian origin of the same general period, although the proportion of the neck to the handles is not common to this type.<sup>37</sup>

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<sup>34</sup> Bass 1976, 301.

<sup>35</sup> Margariti 1998b, 49.

<sup>36</sup> Cook and Dupont 1988, 151-6.

<sup>37</sup> Cook and Dupont 1988, 170-7.

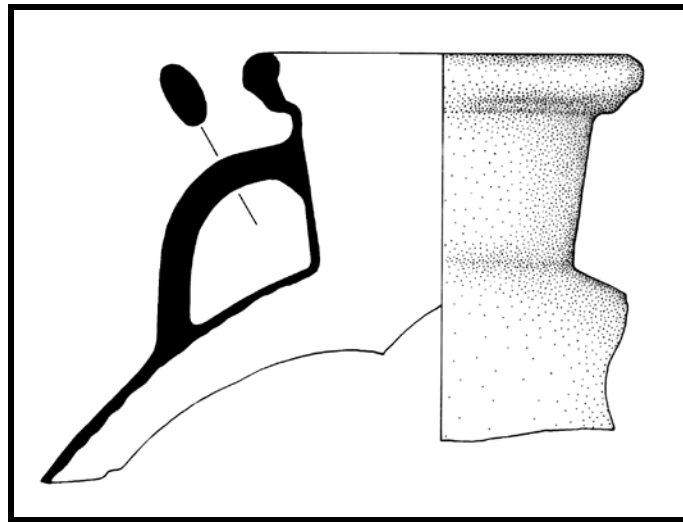


Fig.18. Amphora shoulder/neck SD 20

SD 20 (fig. 18) – Amphora Shoulder/Neck

Survey Designation: Item F.

Dimensions: Pres. H: 0.230 m, Rim D: 0.175 m, Th: 0.040-0.060 m.

Description: Amphora neck fragment with part of the shoulder and a single handle preserved. The fragment, now in two pieces, is slightly encrusted on both the interior and exterior surfaces. It is made of a reddish brown to dark brown fabric. Out of all of the intrusive material associated with the wreck site, the fabric of SD 20 most closely resembles that of the main assemblage. Concentric ridges, indicative of wheel marks, are clearly visible on the interior of the neck and shoulder. The boldly set off rim increases in diameter as it flares outwards at a 45° angle, and then turns inward to form a rounded and smoothed top. A single flattened handle rises vertically from the shoulder to just above mid-height of upward-flaring neck. No stamp or graffiti visible.

Provenience: Bass compares SD 20 with Middle Helladic parallels, including a neck fragment from Krisa, the top of a four-handled pithos from Eutresis,<sup>38</sup> and a similar neck fragment of a Middle Helladic Yellow Minyan hydria from Eutresis.<sup>39</sup> Additional hydriae from Eleusis dating to the end of the Middle Helladic period have also been considered comparanda.<sup>40</sup> Earlier reference to Middle Helladic parallels for SD 20 may perhaps be attributed to the fact that originally the artifact was considered likely to belong to the main ceramic assemblage. Upon further examination, it appears that the particular fragment can instead be tied to the pseudo-Samian tradition, likely belonging to the sixth or fifth century B.C.E.<sup>41</sup> The assemblage of pseudo-Samian amphorae recovered from the site of the Tektaş Burnu shipwreck provide a strong parallel to SD 20, although they carry a thicker rim, that still, however, maintains the same characteristic shape.<sup>42</sup>

#### SD 21 (fig. 19) – Amphora Body

Survey Designation: Item G.

Dimensions: Pres. H: 0.450 m, Th: 0.010 m.

Description: Amphora body fragment. It is made of brown to reddish-brown fabric and reveals wheel marks along part of the interior surface, with other areas being very uneven. The slim body tapers towards a foot stepped inward at the base of a cylindrical

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<sup>38</sup> Bass 1976, 301.

<sup>39</sup> Goldman 1931, 165.

<sup>40</sup> Mylonas 1975, 92-3.

<sup>41</sup> Cook and Dupont 1988, 178-190.

<sup>42</sup> Carlson 2003, 583-590.

neck of almost the same diameter. No handles have survived and no stamp is present.

Provenience: SD 21, although fragmentary and lacking diagnostic elements, is reminiscent of the first century B.C.E. – first century C.E. pseudo-Koan amphora type.<sup>43</sup>

It is too narrow, however, to fall within the more common Dressel 2-4 varieties such as the one recovered from Skerki Bank.<sup>44</sup>

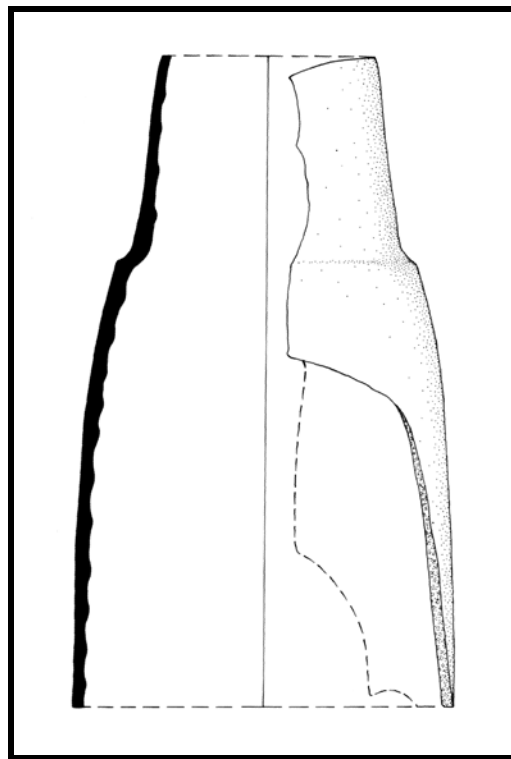


Fig.19. Amphora SD 21

<sup>43</sup> Cemal Pulak, personal communication, December 2007.

<sup>44</sup> McCann 2001, 260-1.

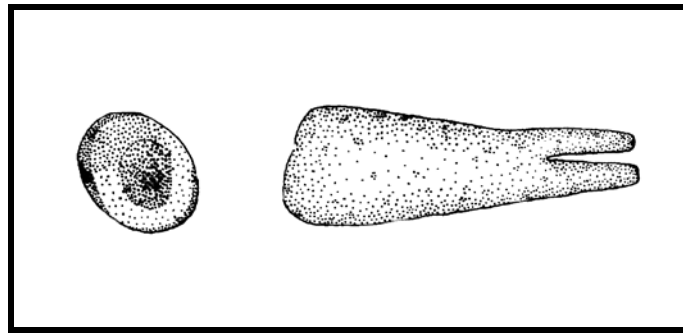


Fig.20. Lead fishline sinker SD 22

SD 22 (fig. 20) – Lead Fishline Sinker

Excavation Designation: DC 109.

Dimensions: H: 0.065 m, Base: 0.023 x 0.020 m.

Description: Irregular conical lead sinker with a depression on its base formed during cooling of the cast piece. A slit on the top narrower end extends to a depth of 1.10 cm.

Provenience: SD 22 is of unknown provenience due to its generic nature.

SD 23 (fig. 21) – Amphora Neck

Excavation Designation: GB 1.

Dimensions: Pres. H: 0.122 m, Mouth D: 0.150 x 0.135 m.

Description: Amphora neck fragment recovered near the beach at a depth of 1.5 m.

Large parts of the lower end of the handles and most of the shoulder is missing. The fragment is slightly encrusted on both the interior and exterior surfaces. It is unevenly constructed of very dark brown clay with white grit. The top of the shoulder is inset by a distinct step 0.3 cm deep, and continues to an irregular cylindrical neck with thickened

rounded rim slightly undercut in places. The flat handles are very irregularly placed, one almost touching the rim, the other less curved. The neck bulges irregularly where the handles attached to it. Several cracks are visible on the rim and neck. No stamp or graffiti visible.

Provenience: SD 23 closely resembles a late sixth century B.C.E to early fifth century B.C.E. amphora in the Bodrum Museum collection characterized as Greco-Marsilian.<sup>45</sup>

Due to the close relationship between Greco-Marsilian and Corinthian types, SD 23 may also fall within the contemporary range of the latter.

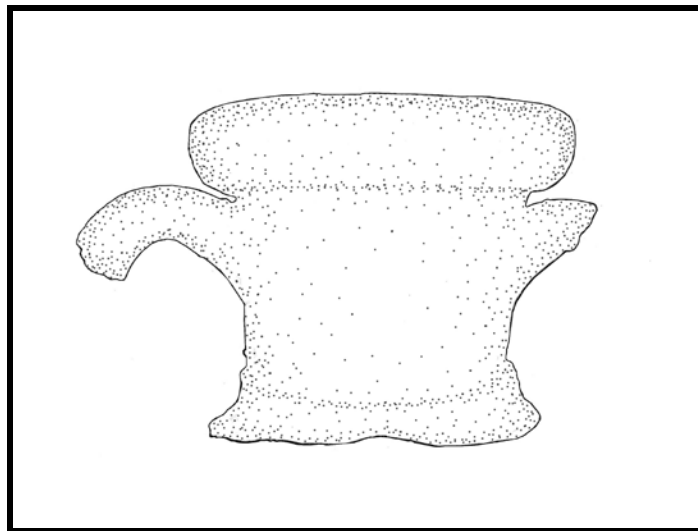


Fig.21. Amphora neck SD 23

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<sup>45</sup> Alpözen et al. 1995, 81.

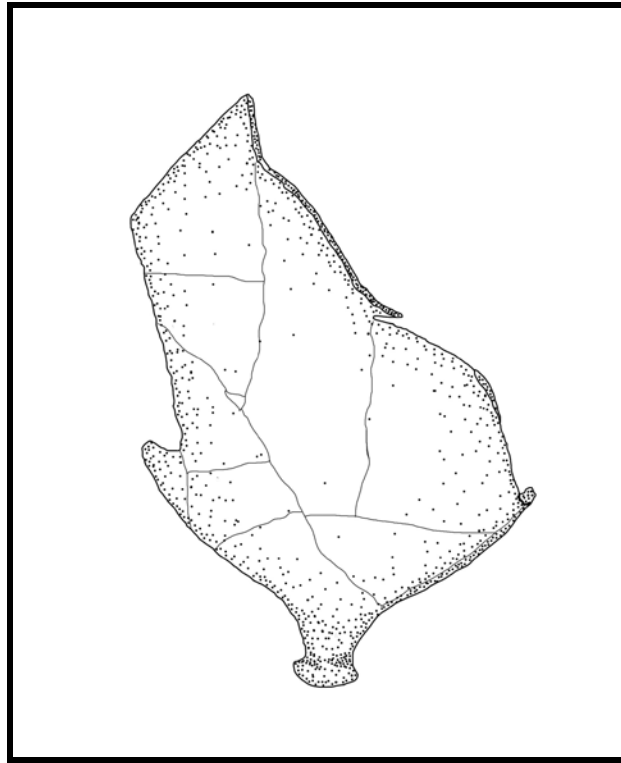


Fig.22. Ceramic base and body SD 24

SD 24 (fig. 22) – Ceramic Base and Body

Dimensions: Pres. H: 0.490 m.

Description: Ceramic base and partial body of a moderately-sized vessel consisting of more than ten fragments. The fragments were found off the beach slightly encrusted on both the interior and exterior surfaces. The base is made of a light brown buff fabric with a reddish-brown slip, now eroded off most of the surface. Interior wheel marks are clearly visible both along the body and the pointed foot, which ends in an eroded toe that extends outward. The body follows a soft, rounded, convex angle outwards from the short but distinct concave foot.

Provenience: Due to its fragmentary nature and poor documentation, it is not possible to attribute SD 23 to any particular amphora type with any certainty, although it most likely belongs to the Greco-Roman period.



## CHAPTER VI

### SUMMARY OF PARALLELS

The vessels that were recovered at Sheytan Deresi (SD) have yet to produce concrete parallels in the archaeological record, although several demonstrate close similarities with artifacts discovered at other sites. Extensive research has been undertaken by Roxani Margariti<sup>46</sup> in this regard, as well as earlier by George Bass,<sup>47</sup> both of whom reached conclusions regarding the assemblage that support the data produced by the scientific analyses (see below). What follows is an evaluation of parallels that have been identified for each of the six respective vessel types of the main Sheytan Deresi assemblage. As particularly strong parallels for any of the six ceramic types originating from the wreck site have yet to be located, the following accounts are not intended to be comprehensive (earlier works have addressed parallels in detail), but represent a summary of what was until recently the state of research, complemented by new information uncovered during this study. A relative regional chronology of the Bronze Age Aegean is included for reference purposes (table 3).

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<sup>46</sup> Margariti 1998.

<sup>47</sup> Bass 1976; Bass 1984.

Table. 3. Relative Chronology of the Bronze Age Aegean

<b>PERIOD</b>	<b>APPROXIMATE CHRONOLOGY (B.C.E)</b>	<b>CORRESPONDING PERIOD &amp; APPROXIMATE CHRONOLOGY (B.C.E.)</b>
Early Minoan I	3100-3000 to 2700-2650	Early Helladic I
Early Minoan IB	(2700-) 2650	
Early Minoan IIA	2650 to 2450-2350	Early Helladic II
Early Minoan IIB	2450-2350 to 2200-2150	
Early Minoan III	2200-2150 to 2050-2000	Early Helladic III
Middle Minoan IA	2050-2000 to 1925-1900	Middle Helladic I
Middle Minoan IB	1925-1900 to 1900-1875	
Middle Minoan II	1900-1875 to 1750 -1720	Middle Helladic II
Middle Minoan III A (-B)	1750-1720 to 1700-1680	Middle Helladic III
Middle Minoan IIIB	1700-1680 to 1675-1650	
Late Minoan IA	1675-1650 to 1600-1550	Late Helladic I (1680 to 1600 -1580)
Late Minoan IB	1600-1550 to 1490-1470	
Late Minoan II	1490-1470 to 1435-1405	Late Helladic IIA (1600-1580 to 1520/1480) Late Helladic IIB (1520/1480 to 1445/1415)
Late Minoan IIIA: 1	1435-1405 to 1390-1370	Late Helladic III
Late Minoan IIIA: 2	1390-1370 to 1360 – 1325	
Late Minoan IIIB	1360-1325 to 1200/1190	

After (Manning 1995, 217)



Fig. 23. Photograph of pithos 1.10.81 (with part of support structure visible)

It is important to note the existence of two ceramic vessels currently stored in the Bodrum Museum of Underwater Archaeology that are considered of uncertain provenience but that likely originate from the bay surrounding the Sheytan Deresi site, if not from the site itself. Pithos 1.10.81<sup>48</sup> was presented to the museum on November 28, 1980 by a customs' official, who claimed to have found it near the area of Sheytan Deresi (fig. 23).<sup>49</sup> The pithos is essentially identical to SD 10 - SD 12 and with a fair amount of certainty can be associated with the main ceramic assemblage of the wreck

<sup>48</sup> Pithos (1.10.81) has a perimeter of 2.20 m, a height of 0.94 m, a base diameter of 0.014m and a mouth diameter of 0.305 m. Margariti 1998b, 72.

<sup>49</sup> Margariti 1998b, 72.

site. An unnumbered, well-preserved amphora of the same type as SD 6 – SD 8 is also currently stored in the amphora depository of the museum, although it is not accompanied by any provenience information. The latter was not available for examination by the author during his visits to the museum, but is also considered related to the Sheytan Deresi main assemblage.<sup>50</sup>

### *The Amphoriskos Type*

Variations of the Sheytan Deresi amphoriskos type exemplified by SD 1, SD 2, and SD 3, appear in the Aegean region from the Bronze Age onward. Broadly speaking, the earliest parallel to date is a Late Helladic I-II hydria from Krisa in Phocis, although its proportions and size differ from those exhibited by SD 1.<sup>51</sup> Other Middle Helladic sites that have produced similar ceramic vessels include Eutresis in Boeotia,<sup>52</sup> as well as Prosymna in the Argolid,<sup>53</sup> and the Shaft Graves at Mycenae.<sup>54</sup> Similar vessels appear at Troy VI, classified under types C 45 and C 49.<sup>55</sup> In the Late Helladic period closer parallels have been located on Kos, where Late Bronze Age burials have yielded a number of vessels that can be attributed to the same general type, although they have taller necks and a slightly different handle placement.<sup>56</sup> Similar vessels continue to

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<sup>50</sup> Margariti 1998b, 22.

<sup>51</sup> Bass 1976, 299.

<sup>52</sup> Goldman 1931, 178-9, fig. 247.

<sup>53</sup> Blegen 1937, 387, pl.IV, fig. 651.

<sup>54</sup> Bass 1976, 299 referring to Karo 1930, 95, fig. 24, pl. CXN.

<sup>55</sup> Blegen, Caskey and Rawson 1953, 16, 38, 64, pls. 294: C45, C49, and 382:37.1092.

<sup>56</sup> These belong to the class of Late Helladic pithoid jars, which Furumark 1941, 38, 594 describes as types 50-60 and 61; Margariti 1998b, 15.

appear at sites such as Iron Age Nichoria and Kokevi, providing continuity with the Geometric and Archaic varieties of the shape.<sup>57</sup>

Bass refers to a parallel of particular interest, a two-handled storage jar from Beycesultan in western Anatolia that first appears in the late Middle Bronze Age.<sup>58</sup> The importance of the vessel lies in its slit handle features, which appear to be identical to those of SD 1, while handle placement and the presence of three parallel grooves or ridges around the vessel's circumference also correspond to features of SD 1. The two-handled jar from Beycesultan, however, is unlike SD 1 in both body proportions and profile.<sup>59</sup> Margariti also draws attention to a coarse pithoid jar from Trianda on Rhodes which shares identical slits on its horizontal handles, although it carries two additional vertical handles with no slits.<sup>60</sup> A Late Minoan IA three-handled storage jar from Mallia in Crete carries triple incisions,<sup>61</sup> while such slit handles are also present in Early and Middle Helladic Pylia in Messinia.<sup>62</sup>

The amphoriskos type encountered at Sheytan Deresi, therefore, has a wide regional and temporal distribution, with only broad shape-related or handle-related parallels.

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<sup>57</sup> Margariti 1998b, 15 referring to McDonald, Coulson and Rosser 1983, 71, 113, 256, fig. 3: 15 and Coulson 1986, 51, 102-3, pl. 12:304.

<sup>58</sup> Bass (1976, 299) referring to Lloyd and Mellaart 1965, 126, fig. P.29-6.

<sup>59</sup> Margariti 1998b, 16.

<sup>60</sup> Margariti 1998b, 16.

<sup>61</sup> Bass 1976, 299.

<sup>62</sup> Korres 1977, pl.153 and Korres 1980, 156.

### *The Small Jug Type*

The small jug type as exemplified by SD 4 and SD 5 consists of a simple and utilitarian shape that produces fair parallels throughout the Aegean and Anatolian regions, without necessarily being particularly close to any one example. Bass discusses a resemblance with Trojan shape B25, which due to the fragmentary nature of examples, can only tentatively be linked with Middle Helladic traditions.<sup>63</sup> Approximate parallels, similar in character and in shape to SD 4 and SD 5, originate in the Middle Minoan III to Late Minoan I periods on Crete, from sites such as Kythera,<sup>64</sup> Mallia,<sup>65</sup> Phaistos,<sup>66</sup> Knossos,<sup>67</sup> and Kommos.<sup>68</sup> Margariti also cites parallels from the Dodecanese region, stressing a particular jug (inv. 1214) at the Archaeological Museum of Kos, although decorated and slightly smaller than the SD specimens.<sup>69</sup> At the same time, Rutter is in favor of a Central-Southwestern Anatolian origin for certain of the SD small jug parallels,<sup>70</sup> with a fairly good, but squatter parallel coming from Liman Tepe.<sup>71</sup>

Once more, the shape exhibits a general likeness with examples from a wide regional and temporal distribution, which, in part due to its utilitarian and coarse nature, and the lack of any painted decoration, cannot be convincingly tied to a particular origin.

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<sup>63</sup> Bass (1976, 299) referring to Blegen, Caskey and Rawson 1953, 56-7, 385, pl. 320:34.366.

<sup>64</sup> Coldstream and Huxley 1973, 239, pl.72:45.

<sup>65</sup> Demargne and de Santerre 1953, 47, 57, pl.XXXI-1.

<sup>66</sup> Pernier 1935, 285, fig. 167-5.

<sup>67</sup> Momigliano 1991, 236, pl. 54:125.

<sup>68</sup> Rutter 2006, 149.

<sup>69</sup> Margariti 1998b, 21.

<sup>70</sup> Rutter 2006, 149.

<sup>71</sup> Günel 1999, 81.

### *The Piriform Amphora Type*

The piriform amphora type exemplified by SD 6, SD 7, SD 8, and the unnumbered specimen in the Bodrum Museum, may, perhaps due to its uncommon shape, present the best opportunity for locating good parallels for the Sheytan Deresi ceramic vessels. Parallels similar, yet still distinct from SD 6, SD 7, and SD 8, have been uncovered from Helladic, Aegean, Anatolian and Cretan sites. Middle Bronze Age Thessaly,<sup>72</sup> Middle Helladic II Asine,<sup>73</sup> Middle Helladic Lerna,<sup>74</sup> as well as Kalymnos<sup>75</sup> have all produced ceramics of comparable shape, while Bass mentions instances of ceramics from Thessaly,<sup>76</sup> Knossos,<sup>77</sup> and Beycesultan<sup>78</sup> that also carry plastic knobs similar to those on SD 6.

It appears that the best parallels for the piriform amphora type come from Crete. Examples of similar vessels occur at Myrtos, within Early Minoan II contexts,<sup>79</sup> while even earlier, a slightly squatter example from Platyvola cave dates to the Final Neolithic.<sup>80</sup> Notably, some of the Myrtos jars feature a small protrusion at the base of the neck.<sup>81</sup> Bass refers to another early example of a similar but squatter polychrome vase originating from Middle Minoan IIB Phaistos.<sup>82</sup> Fragments from Palaikastro indicate a

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<sup>72</sup> Bass 1976, 299 referring to Milojevic 1959, 28-9, fig. 26:3-4.

<sup>73</sup> Bass 1976, 299 referring to a weaker parallel found in Frödin and Persson 1938, 274-7, fig. 191.

<sup>74</sup> Margariti 1998b, 27.

<sup>75</sup> Margariti 1998b, 27.

<sup>76</sup> Bass 1976, 299 referring to Milojevic 1959, 28-9.

<sup>77</sup> Bass 1976, 299 referring to Evans 1921, 55.

<sup>78</sup> Bass 1976, 299 referring to Lloyd and Mellaart, 1965, 105, 107, fig.P.30:4.

<sup>79</sup> Warren 1972, 141-2, figs.77-8.

<sup>80</sup> Godart and Tzedakis 1992, pl. XLVIII.

<sup>81</sup> Margariti 1998b, 26 referring to Warren 1972, 141, fig. 77.

<sup>82</sup> Bass 1976, 299 referring to Evans 1921, 257 and Pernier 1935, pl.XXXII.

polychrome vessel of the same shape,<sup>83</sup> while an additional example may be found at the sanctuary of Anemospelia, near Archanes on Crete.<sup>84</sup> A particular vessel originating from the Middle Minoan II Royal Pottery stores at Knossos, whose early development is traced by Evans to a Middle Minoan I pot from the Kouloura Houses in Knossos,<sup>85</sup> appears to be the most similar to the SD amphorae. The example to which Bass refers<sup>86</sup> is among three similar vessels that have been found in the Room of the Jars, and is considered to be part of Group I according to MacGillivray's classification system, dating to the Middle Minoan IB period.<sup>87</sup> New published illustrations allow for a more thorough examination of the parallels.<sup>88</sup> In overall body, neck and rim shape, along with handle placement and arrangement, these tall amphorae are very similar to the piriform amphora type of the SD ceramic assemblage. Their bases, however, are wider in order to support the vessels upright, allowing for a more gradual inward angle along the lower part of their bodies. They are also decorated in the White-banded Style, with one or more white bands running along the circumference of their bodies.<sup>89</sup>

### *The Krater Type*

The krater type is represented solely by SD 9 and appears particularly difficult to trace in the archaeological record. It is central among the finds that has resulted in the

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<sup>83</sup> Bosanquet and Dawkins 1923, 26, fig.16.

<sup>84</sup> Sakelarakis 1991, 145, fig. 123.

<sup>85</sup> Evans 1921, 83-84, 571-572.

<sup>86</sup> Bass 1976, 299.

<sup>87</sup> MacGillivray 1998, 38.

<sup>88</sup> MacGillivray 1998, pl.121-2.

<sup>89</sup> MacGillivray 1998, 38.



questioning of Sheytan Deresi's Bronze Age date, as overall characteristics, and especially reflex handles comparable to those present on SD 9, are typical of the Late Geometric I-II periods. Margariti, however, points out that handles such as those on SD 9 appear in various contexts, including Early Bronze Age Thessaly, and, therefore, should not be used as sole indicators of a later date.<sup>90</sup>

A solid parallel from any context for SD 9 remains elusive, particularly considering its impressive size. Even though there are a number of small open vessels from Late Minoan Tylissos,<sup>91</sup> Middle Helladic Eutresis,<sup>92</sup> Asine,<sup>93</sup> and Mycenae,<sup>94</sup> similar in shape to the krater, most can only qualify as bowls of a much smaller size than SD 9. Margariti states that a deep bell-shaped krater from a tholos tomb at Moulia in east Crete, possibly dating to the Late Minoan IIIC period, although not entirely resembling SD 9, should be considered a parallel due to its general character, larger size and handle configuration.<sup>95</sup> What makes it a particularly interesting parallel is the similarity of clay protuberances at the points of attachment of the handles, which are, however, at an oblique angle to the body. A further plain pithoid bowl from Trianda on Rhodes, is also comparable to the general characteristics of SD 9.<sup>96</sup> Furumark compares this example to

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<sup>90</sup> Margariti 1998b, 31 referring to Milojevic 1959, 52.

<sup>91</sup> Bass 1976, 300 referring to Hazzidakis 1921, 27, 29, fig. 12c.

<sup>92</sup> Goldman 1931, 127-8, 133-4.

<sup>93</sup> Dietz 1991, 51, fig. 10:41.

<sup>94</sup> Mylonas 1973, pl. 106.

<sup>95</sup> Margariti 1998b, 30-1 referring to Xanthoudides 1904, 32-3, pl.3; Desborough 1964, 177, 188; Desborough 1952, 269-70, 327 and Furumark 1941, 47.

<sup>96</sup> Margariti 1998b, 31 referring to Monaco 1941, 151-2.

Middle Minoan IIIB - Late Minoan IIIB vessels from Knossos,<sup>97</sup> one of which, Margariti expresses, may possibly provide the most satisfying parallel to date for the krater.<sup>98</sup>

### *The Strap-Handled Pithos Type*

The strap-handled pithos type exemplified by SD 10, SD 11 and SD 12, in addition to the aforementioned pithos 1.10.81, also does not appear to have precise parallels within the archaeological record, although there are a number of ceramic vessels that share common features with the type.

The most prominent feature of these pithoi is their horizontal loop handles. Although such handles are typical of the Eastern Mediterranean, and in particular during the Archaic period, “basket handles” appear in diverse contexts, ranging chronologically from the Early Bronze Age to late antiquity, and are spread geographically over the entire Eastern and Central Mediterranean.<sup>99</sup> They are therefore not in themselves indicative of date or provenience, and occur on a variety of ceramic shapes, including stamnoi, amphorae, bridge-spouted jars, pyxides and kalathoi.<sup>100</sup> A number of the parallels noted by Bass<sup>101</sup> and Margariti<sup>102</sup> are in regards to smaller vessels, skyphoi, or hole-mouth spouted jars, which tend to carry an additional set of handles and do not provide particularly strong parallels.

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<sup>97</sup> Furumark 1941, 173, 185. Although Furumark dates the vessels to Late Minoan IIIB, Evans 1921, 365 dates one of kraters to Middle Minoan IIIB based on stratigraphic data.

<sup>98</sup> Margariti 1998b, 31.

<sup>99</sup> Margariti 1998b, 35.

<sup>100</sup> Bass 1976, 300 and Margariti 1998b, 35 referring to Betancourt 1985, figs. 34, 48, 65, 77, 81:A, 109, 112; pls. 8:F, 11:B, 13:I, 18:C, 22:A, 26:C.

<sup>101</sup> Bass 1976, 300.

<sup>102</sup> Margariti 1998b, 34-6.

There is, however, at least one Late Minoan I conical/piriform pithos from Zakros which carries horizontal handles that surpass the height of the mouth,<sup>103</sup> although the published illustration does not lend itself to detailed examination.<sup>104</sup> There are some additional Late Minoan I pithoi from Mochlos, located in situ, whose upper bodies resemble those of the SD pithoi.<sup>105</sup> The same can be said for their hole-mouth forms, rims and horizontal handle configuration. The Mochlos examples, however, carry an extra set of vertical handles, and according to Margariti, were reported by the excavator not to resemble the SD pithoi in shape and to be made of phyllite-tempered fabric.<sup>106</sup> All in all, convincing parallels that share the overall size, narrow base, piriform body shape, hole-mouth and horizontal handles of the SD pithoi have not emerged. Perhaps, as Margariti notes, specialized use in maritime trade may explain the lack of more satisfying parallels for this type at excavated land settlements in Crete, the Aegean islands, or Anatolia.<sup>107</sup>

#### *The Handleless Ovoid-conical Pithos Type*

The handleless ovoid-conical pithos type is exemplified by SD 13, SD 14, SD 15 and SD 16. It is perhaps the group most reminiscent of Archaic period shapes, although here too strong parallels from any period have yet to be uncovered.

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<sup>103</sup> Platon 1965, 198, pl. 241.

<sup>104</sup> Margariti 1998b, 36.

<sup>105</sup> Soles and Davaras 1994, 428, pl. 93, 106a.

<sup>106</sup> Margariti 1998b, 37.

<sup>107</sup> Margariti 1998b, 37.

Early ceramic parallels that resemble the SD type come from Late Bronze Age Nichoria in the southwestern Peloponnese<sup>108</sup> and Middle Helladic Krisa in Phocis.<sup>109</sup> Furumark states that ovoid pithoi were in use since the early Middle Helladic period, while his Mycenaean vessel type 13 is the closest that can be associated with the SD pithoi. A Middle Minoan III – early Late Minoan undecorated funerary vessel from Langada cemetery on Kos somewhat resembles the SD pithoi but is smaller, squatter and more globular.<sup>110</sup> It does, however, carry two very irregular horizontal ridges near the base, similar to the SD type. A further Late Minoan IB – Late Minoan II example that originates from Trianda on Rhodes, also carries these ridges but resembles the SD pithoi to a lesser degree.<sup>111</sup>

Some of the closest parallels for the SD pithoi come from eighth and seventh centuries B.C.E. Thera<sup>112</sup> and Rhodes,<sup>113</sup> while somewhat weaker parallels come from the Argolid,<sup>114</sup> Eleusis,<sup>115</sup> Oinoe and Marathon,<sup>116</sup> the majority of which are funerary urns. In none of the instances, however, is there a particularly strong resemblance to the SD pithoi that could be used to provenience the ceramics, especially since other data resulting from scientific analyses (see below) suggest a much earlier date for the SD ceramic assemblage.

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<sup>108</sup> McDonald and Wilkie 1992, 508, pl. 9:73.

<sup>109</sup> Jannoray and van Effenterre 1938, 117, fig. 7.

<sup>110</sup> Morricone 1965-1966, 254, 294, fig.280.

<sup>111</sup> Monaco 1941, 129-130 and Furumark 1950, 173, fig.7:117-118.

<sup>112</sup> Dragendorf 1903, 226-227, fig. 424b.

<sup>113</sup> Jacopi 1929-1931, 333, pl.VIII:CLXXXVI.

<sup>114</sup> Courbin 1966, pl.106.

<sup>115</sup> Mylonas 1975, 84-7, pl.216, 97, 99, pl.230-1, 114, 115, pl.243.

<sup>116</sup> Arapoyianni 1985, 213, 214, pl.88, 89a.

## CHAPTER VII

### SCIENTIFIC ANALYSES

#### *The Petrographic Analysis*

Ceramic petrographic analysis is a technique developed for observation and identification of small rocks and minerals in ceramic fabrics. It involves creating thin-sections of the material being studied, which are subsequently viewed through a polarizing microscope at a magnification of up to 100 times. A sample containing minerals may diffract light so that they are visible in cross-polarized light with the degree of diffraction enabling their identification. The presence or absence of minerals and small rocks in the thin-section, together with their texture and range of sizes, defines the fabric of the pottery, or petrofabric. The petrofabric of a particular ceramic may be diagnostic of its origin as the geology and environment of the region around a kiln-site where the pottery was manufactured generally dictate what appears in the pottery.<sup>117</sup>

Thin-sections from the majority of the Sheytan Deresi ceramic assemblage (figs. 24-5) were submitted for petrographic analysis to Yuval Goren of the Department of Archaeology and Ancient Near Eastern Cultures, Tel-Aviv University, who upon examination of the samples came to the following conclusions.

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<sup>117</sup> Mason (2007, 27 July) presents an overview of the Ceramics Petrography method.

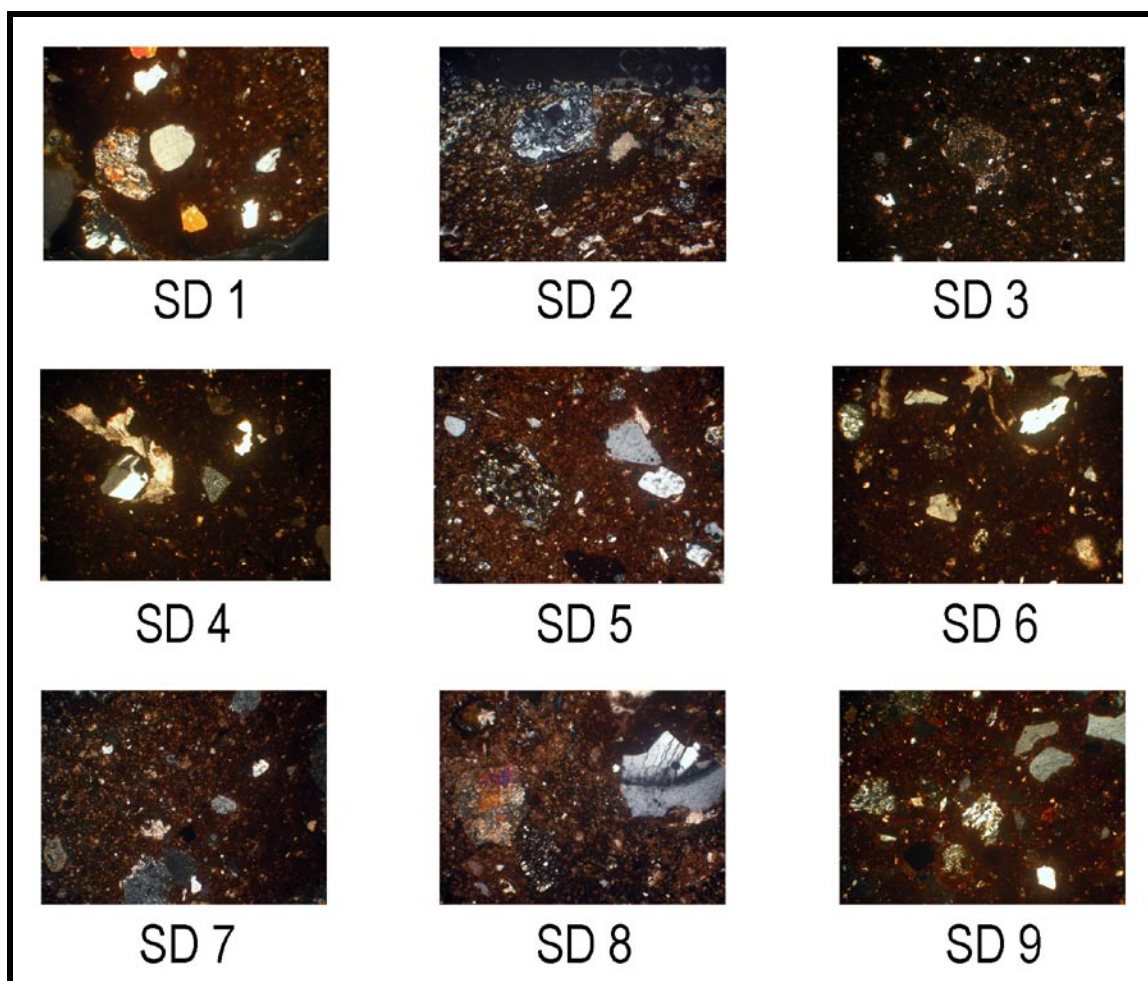


Fig. 24. Sample petrographic analysis microphotographs of the small SD ceramics

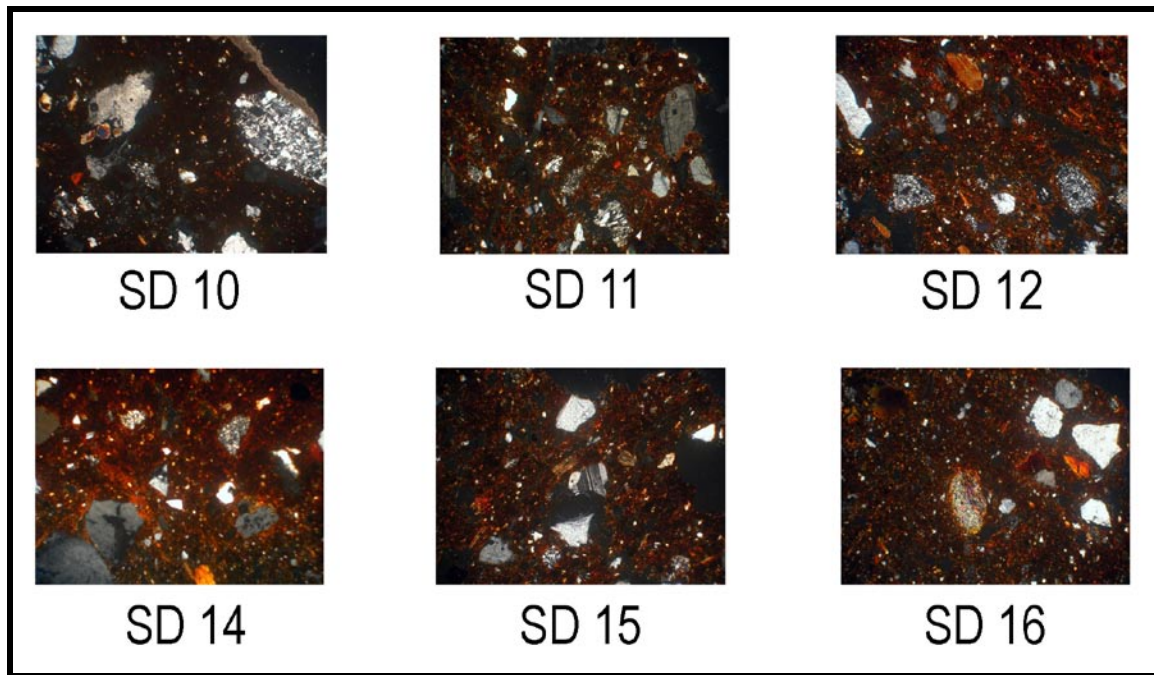


Fig. 25. Sample petrographic analysis microphotographs of the large SD ceramics

The matrix of the clay in all samples is reddish-tan in plain polarized light (PPL), containing about 20% micritic calcite particles ranging usually around 50 microns in size, with certain rarer cases extending up to 100 microns. In the latter instances the argillaceous component of the matrix is either nearly isotropic (devoid of any optical properties, or birefringence) most likely due to high firing temperature, or highly birefringent, where the micritic calcite is nonexistent and the clay is highly micaceous (eg. SD 10, 11, SD 12, SD 14, SD 15). Laths of mica minerals including muscovite and biotite, sometimes reaching the size of ~200 microns lengthwise, are frequent (about 5%). Although there appear to be two clay types (one which is marly, containing the micritic calcite and the other which is purely argillaceous and richer in mica minerals),

the nature of these clay types, and especially the composition of the inclusion assemblage, suggests a *single* and *very distinctive* origin.<sup>118</sup>

The inclusions as a whole are made of poorly-sorted sand which is composed of coarse, angular and even idiomorphic quartz particles; coarse, angular and sometimes idiomorphic plagioclase feldspars, and a series of metamorphic rock fragments including schist, phyllite, quartzite, and pyroxenite. Ultra-basic rock fragments and their derived minerals include peridotites and large particles of serpentine. The sedimentary rock fragments in the inclusions include limestone, chert, and siltstone. Rare particles of olivine basalt are also apparent in some samples.<sup>119</sup>

Accordingly, the compositional, textural and mineralogical characteristics of the samples suggest that the source area of the clay should be sought on the margin of geologic features referred to as ophiolite complexes. Ophiolite complexes are presumed to represent oceanic crust which has been thrust onto continental crust. When structurally complete, an ophiolite consists of a thin uppermost veneer of oceanic sediment (which may include oceanic clay and radiolarian cherts) overlying quenched pillowed basalts and more mature lavas, which in turn overlie a sheeted dolerite complex. Beneath the dolerites are texturally isotropic gabbros, which lie over layered gabbros, peridotites and pyroxenites (or their serpentinized remains). These largely basic and ultrabasic

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<sup>118</sup> Yuval Goren, personal communication, April 2007.

<sup>119</sup> Yuval Goren, personal communication, April 2007.



components are cut by late-stage intrusions of coeval plagiogranite and are located above older oceanic sediments including radiolarites and limestone. As a consequence of its formation at spreading ridges, oceanic crust – and therefore ophiolites – experience ocean-floor metamorphism, which characteristically produces assemblages of greenschist and amphibolite facies. These metamorphites are often undeformed.<sup>120</sup>

The results of the analysis suggest that the ceramic fabrics present in the Sheytan Deresi assemblage are a fairly homogenous group, something which strengthens the case for all the artifacts belonging to a single wrecking event. There does appear to be a variation in the fabric used with the larger vessels, as opposed to the smaller ones, but this is something which is consistent with construction practices. In Goren's estimation, it appears statistically almost impossible to obtain such a situation by the accidental deposition of vessels originating from different shipwrecks over a sequence of time.<sup>121</sup> This, in addition to the statistical improbability of two wrecks with similar features lost within such a specific geographic spread, and not against a reef or rocky coast, lead to the conclusion that the assemblage should be treated as a homogenous group, originating from a single ship.

Locating the provenience of the ceramic assemblage on the basis of the petrographic properties of the clay is particularly difficult. Ophiolitic belts appear in certain locations

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<sup>120</sup> Yuval Goren, personal communication, April 2007.

<sup>121</sup> Yuval Goren, personal communication, April 2007.

along the south Turkish coast, in many parts of mainland Greece, in some of the Aegean islands, including southern Crete, and in the circum-Troodos area of western Cyprus, near some major sites such as Kalavassos, Alasa and Kouklia.<sup>122</sup> However, the matter becomes more complicated when one considers the fact that ophiolite complexes need not only occur in belts, but also as isolated formations or in mixed geologic deposits. Therefore, smaller ophiolite complexes may be located anywhere along the coast or further inland where the general phenomenon occurs;<sup>123</sup> one cannot simply examine and isolate the larger belts for provenience purposes.

What is possible, however, is eliminating certain areas from consideration, given the lack of ophiolite belts in the vicinity and/or the absence of similar clay fabrics in regional petrographic studies. Such areas, according to Goren,<sup>124</sup> include the regions of Egypt, as there are no ophiolites in the relevant parts of Egypt and Egyptian fabrics are entirely different in by nature, and also the Levant, unless one incorporates the northernmost part of the Syrian coast, along the Baer-Bassit area, near the outlet of the Orontes River (Nahr el 'Asi). The Baer-Bassit ophiolite, which lies north of Latheqiya (and east of Ras-Shamra - Ugarit), and the more northern Kızıldağ ophiolite of the Hatay region in Turkey, are part of the Tauric belt of ophiolites that branch from the broader belt that extends from Iran to the Mediterranean.<sup>125</sup> The sediment used in the Sheytan

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<sup>122</sup> Yuval Goren, personal communication, April 2007.

<sup>123</sup> Ray Guillemette, Research Associate Professor, Texas A&M University Department of Geology & Geophysics, personal communication, April 2007; Andrew Hajash, Professor, Texas A&M University Department of Geology & Geophysics, personal communication, April 2007.

<sup>124</sup> Yuval Goren, personal communication, April 2007.

<sup>125</sup> Yuval Goren, personal communication, April 2007.

Deresi vessels was apparently taken from the "mélange" that usually appears at near edge of an ophiolite, as well as right below it, and therefore from an in situ argillaceous formation. Sites such as Ugarit, Ras Ibn Hani, Tell el Atchana (Alalakh) are all on the margins of the aforementioned areas, but are all also located on the alluvial plains where other sediments appear and, therefore, the clays tend to be a result of alleviation and Aeolian deposition of clasts.<sup>126</sup> The Mersin and Tarsus areas on the Cilician coast, which also neighbor ophiolitic complexes may also be discounted as likely areas of provenience, as they too are located on alluvial plains and rather far away from the existing ophiolite.<sup>127</sup>

#### *The Luminescence Dating Analysis*

Thermoluminescence dating is based on the notion that through the application of heat, electron traps in minerals, set to zero by exposure to high temperature, may be released and measured allowing for a date of firing to be calculated.<sup>128</sup> Typically, the materials analyzed involve ceramics, fired during manufacturing, or materials such as burnt flint. Geological material such as clay contains radioactive elements, whose levels depend on the dose of external radiation received from the environment, as well as the levels existing internally within the material. Alpha and beta particles have poor penetrative ability and thus their effect can be mitigated by removing the outer millimeters of a sample. Consequently, the annual dose of a ceramic material may be calculated from the

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<sup>126</sup> Yuval Goren, personal communication, April 2007.

<sup>127</sup> Yuval Goren, personal communication, April 2007.

<sup>128</sup> Renfrew & Bahn 2001, 151

amounts of radioisotopes present within a ceramic fabric, and the amount of gamma radiation received from the environment.<sup>129</sup> When heated to 500° C, energy lost by electrons as they are evicted from their traps is emitted as light radiation, referred to as thermoluminescence (TL). The thermoluminescence measured is directly proportional to the number of trapped electrons and thus the total radiation dose, something that can then be used to establish a date of firing.<sup>130</sup> In cases where the radioactivity of the burial context cannot be determined, the calculated date is much less accurate.

Optical luminescence dating is similar in principle to thermoluminescence, but instead of relying on heat, this technique relies on minerals that may have been exposed to light. A number of minerals, such as quartz, contain a sub-set of electron traps which are emptied, or bleached, by a relatively short exposure to sunlight. After burial, these traps begin to accumulate electrons once more. A sample's total radiation may be estimated by exposing it to light of a visible wavelength and measuring the resultant optically stimulated luminescence (OSL), or exposing it to light of infrared wavelength, and measuring the resultant infrared-stimulated luminescence (IRSL).<sup>131</sup>

Five ceramic samples from vessels SD 6, SD 7, SD 14, SD 15 and SD 16 were submitted for luminescence dating to James Feathers, Director of the Luminescence Dating Laboratory at the University of Washington. Along with the samples, the laboratory was

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<sup>129</sup> Renfrew & Bahn 2001, 151

<sup>130</sup> Renfrew & Bahn 2001, 152

<sup>131</sup> Renfrew & Bahn 2001, 153.

provided with information regarding their find location such as the nature of the surrounding sediment (silty gray sand), the amount of sediment under which the samples were recovered (0-30 cm), and the water depth of the site (31-33 m). No neighboring sediment sample was available to submit to the laboratory, knowing that this would affect the accuracy range of the dating.

Table. 4. Radioactivity Data of Luminescence Analysis for SD Samples

SAMPLE	$^{238}\text{U}$ (ppm)	$^{232}\text{Th}$ (ppm)	% K	BETA DOSE RATE (Gy/ka)	
				$\beta$ -counting	$\alpha$ -counting/flame photometry
SD 6	2.64 $\pm$ 0.19	7.26 $\pm$ 1.11	1.25 $\pm$ 0.04	1.63 $\pm$ 0.14	1.59 $\pm$ 0.05
SD 7	3.19 $\pm$ 0.23	10.48 $\pm$ 1.17	1.39 $\pm$ 0.01	1.79 $\pm$ 0.15	1.87 $\pm$ 0.05
SD 14	1.84 $\pm$ 0.18	10.83 $\pm$ 1.26	1.24 $\pm$ 0.01	1.46 $\pm$ 0.11	1.56 $\pm$ 0.04
SD 15	0.64 $\pm$ 0.16	14.17 $\pm$ 1.56	1.10 $\pm$ 0.01	1.39 $\pm$ 0.10	1.36 $\pm$ 0.05
SD 16	0.92 $\pm$ 0.17	15.13 $\pm$ 1.62	1.09 $\pm$ 0.06	1.38 $\pm$ 0.10	1.42 $\pm$ 0.07

Radioactivity data for the five samples is presented above (table 4), as well as the beta dose rates determined directly by beta counting and indirectly by derivation from alpha counting (assuming equilibrium) and flame photometry.<sup>132</sup> There was agreement for all samples, suggesting no problems with disequilibrium. Values of  $1.0 \pm 0.5\%$  for  $\text{K}_2\text{O}$ ,  $6.0 \pm 0.3 \text{ ppm}$   $^{232}\text{Th}$ , and  $1.5 \pm 0.5 \text{ ppm}$   $^{238}\text{U}$  were assumed for the sediment, with the high error terms designed to accommodate most possibilities for marine sand.<sup>133</sup> The water was assumed to contain negligible radioactivity. Moisture content was assumed to

<sup>132</sup> Feathers 2006, 1.

<sup>133</sup> Feathers 2006, 1.

be 100% of saturated value for the ceramics and  $30\pm 20\%$  for the sediment. While considerable uncertainty surrounds the external dose rate for these samples, the error is consistent, affecting mainly the absolute ages and not the relative ages among the samples.<sup>134</sup>

Table. 5. Results of Luminescence Dating Analysis for SD Samples

SAMPLE	BASIS	AGE (ka)	CALENDER (yrs B.C.E.)	% ERROR
SD 6	Weighted TL/IRSL	$4.61\pm 0.67$	$2607\pm 672$	14.6
SD 7	IRSL	$4.40\pm 0.70$	$2391\pm 697$	15.9
SD 14	IRSL	$3.27\pm 0.86$	$1264\pm 860$	26.3
	OSL	$5.37\pm 0.53$	$3363\pm 534$	10.0
SD 15	OSL	$30.2\pm 4.6$		15.1
SD 16	OSL	$3.38\pm 0.60$	$1376\pm 598$	17.7

The results of the luminescence data as presented in Feather's report are shown in above (table 5).<sup>135</sup> Equivalent dose was determined by both TL and by IRSL and OSL (see appendix B). Discounting SD 15 for which no reasonable age could be obtained, the only way the other four samples can be shown to be contemporary is to assume that the IRSL determination for SD 14 is the best estimate. In this case the weighted average of all four samples is  $3.92 \pm 0.34$  ka, or  $1910 \pm 340$  B.C.E. However, because of fading,<sup>136</sup> the OSL estimate for SD 14 is considered more reliable. Fading may also affect the TL or IRSL results from SD 6 and SD 7. Weighting the ages of SD 6, SD 7 and SD 14 (OSL)

<sup>134</sup> Feathers 2006, 1.

<sup>135</sup> Feathers 2006, 3

<sup>136</sup> Anomalous fading is the term adopted for the rapid decay at room temperature of the high temperature thermoluminescence glow-peaks signal, contrary to the expected stability predicted by the basic TL kinetic models. Kitis et al. 2006, 3816.

yields an estimate of  $4.90 \pm 0.36$  ka, or  $2890 \pm 360$  B.C.E., while SD 16 cannot be averaged in because it is significantly younger. On purely technical grounds, the 2890 B.C.E. age might seem preferable but this entails rejecting the SD 16 data. The younger age may then seem more reasonable, although that involves rejecting SD 14 OSL data. None of the data from any sample is particularly reliable, and the results are too inconsistent to make an unequivocal choice between the two estimates. As a result, Feathers states that the ceramics date to somewhere between about 1600 B.C.E. and 3200 B.C.E., with the data unable to support a better resolution.<sup>137</sup>

It should be noted that earlier thermoluminescence analysis performed on samples from SD 12 and SD 16 were dated to  $320 \pm 210$  C.E. and  $640 \pm 130$  C.E., respectively, although confidence levels in these results is presented as not very high.<sup>138</sup>

### *The Neutron Activation Analysis*

Neutron Activation Analysis (NAA) is a technique utilized for performing qualitative and quantitative multi-element analysis of major, minor, and trace elements in samples.<sup>139</sup>

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<sup>137</sup> Feathers 2006, 3

<sup>138</sup> Margariti (1998, 63) states that in the report submitted to the Institute of Nautical Archaeology by the University of Oxford Research Laboratory for Archaeology and the History of Art, S. Hall and M.S. Tite state that "errors quoted in association with the age estimates take into account both systematic and random errors (at 68% confidence level) in TL measurements, dose-rate measurements and calibrations of radioactive sources and equipment. However any errors associated with anomalous fading are not included ... The most significant errors in this case came from those associated with the calculation of the archaeological dose and uncertainties associated with the environmental gamma dose."

<sup>139</sup> Glascock (2006, 24 August) presents an overview of Neutron Activation Analysis.

Table. 6. Elemental Composition (%) of NAA SD Samples

SAMPLE	Al %	As %	Co %	Cr %	Fe %	Sb %	Sc %	La %	Mn %	Mg %	V %
SD 6	8.309	0.009	0.006	0.045	15.331	0.00019	0.004	0.011	0.056	5.313	0.008
SD 7	7.684	0.019	0.023	0.142	75.178	0.00068	0.019	0.054	0.278	4.414	0.012
SD 14	8.019	0.029	0.009	0.045	58.515	0.00082	0.011	0.025	0.009	0.056	0.011
SD 15	8.857	0.021	0.007	0.037	41.181	0.0004	0.009	0.018	0.018	2.201	0.01
SD 16	9.028	0.009	0.004	0.019	18.808	0.00028	0.005	0.01	0.028	2.608	0.015

When a neutron interacts with the target nucleus via a non-elastic collision, a compound nucleus forms in an excited state. The compound nucleus will almost instantaneously de-excite into a more stable configuration through emission of one or more characteristic prompt gamma rays. In many cases, this new configuration yields a radioactive nucleus, which also de-excites (or decays) by emission of one or more characteristic delayed gamma rays, but at a much slower rate according to the unique half-life of the radioactive nucleus.<sup>140</sup> Approximately 70% of elements have properties that are suitable for measurement by NAA.<sup>141</sup>

Samples from SD 6, SD 7, SD 14, SD 15 and SD 16 were submitted to Latha Vasudevan of the Texas A&M University Nuclear Science Center. It is important to note that even though every effort was made to sample from uncontaminated core sections of the ceramic fragments, the fragments had been in storage and conservation since their recovery in 1973 and 1975. The procedure that was followed (see appendix C) included

<sup>140</sup> Glascock (2006, 24 August) Neutron Activation Analysis.

<sup>141</sup> Glascock (2006, 24 August) Neutron Activation Analysis.



both short and long irradiation counts in order to identify the most elements possible. Although there is significant variation in the unidentified composition of the samples, Fe, Al and Mg are clearly the predominant identified elements (table 6) (fig. 26). Traces of Sc, Cr, Co, As, Sb, La, V, and Mn were also identified in the majority of the samples. The uniformity of the results reaffirms those of the petrographic analysis in supporting the notion that the main assemblage of ceramics is a homogeneous group. It is hoped that in the future the elemental composition of the samples may aid in establishing a provenience for the wreck. One must keep in mind, however, that these ceramics have remained submerged in seawater for a particularly long period of time, something that may very well have skewed the results both of the NAA analyses, as well as those of the electron microscopy Energy Dispersive Spectroscopy (EDS) (see below). Migratory elements may have both leached from the ceramics, as well as deposited on them, due to the long-term submersion in seawater. Such an effect on trace element concentrations makes direct comparison with ceramics from land sites particularly difficult. As leaching and deposition tend to affect the more mobile elements the most (group 1 and 2 cations), as well as those present in high concentrations in sea water, a solution may lie in discounting certain elements such as Na, K, Ca, Rb, and Cs from comparisons.<sup>142</sup>

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<sup>142</sup> Taylor, Robinson and Gibbins 1997, 14.

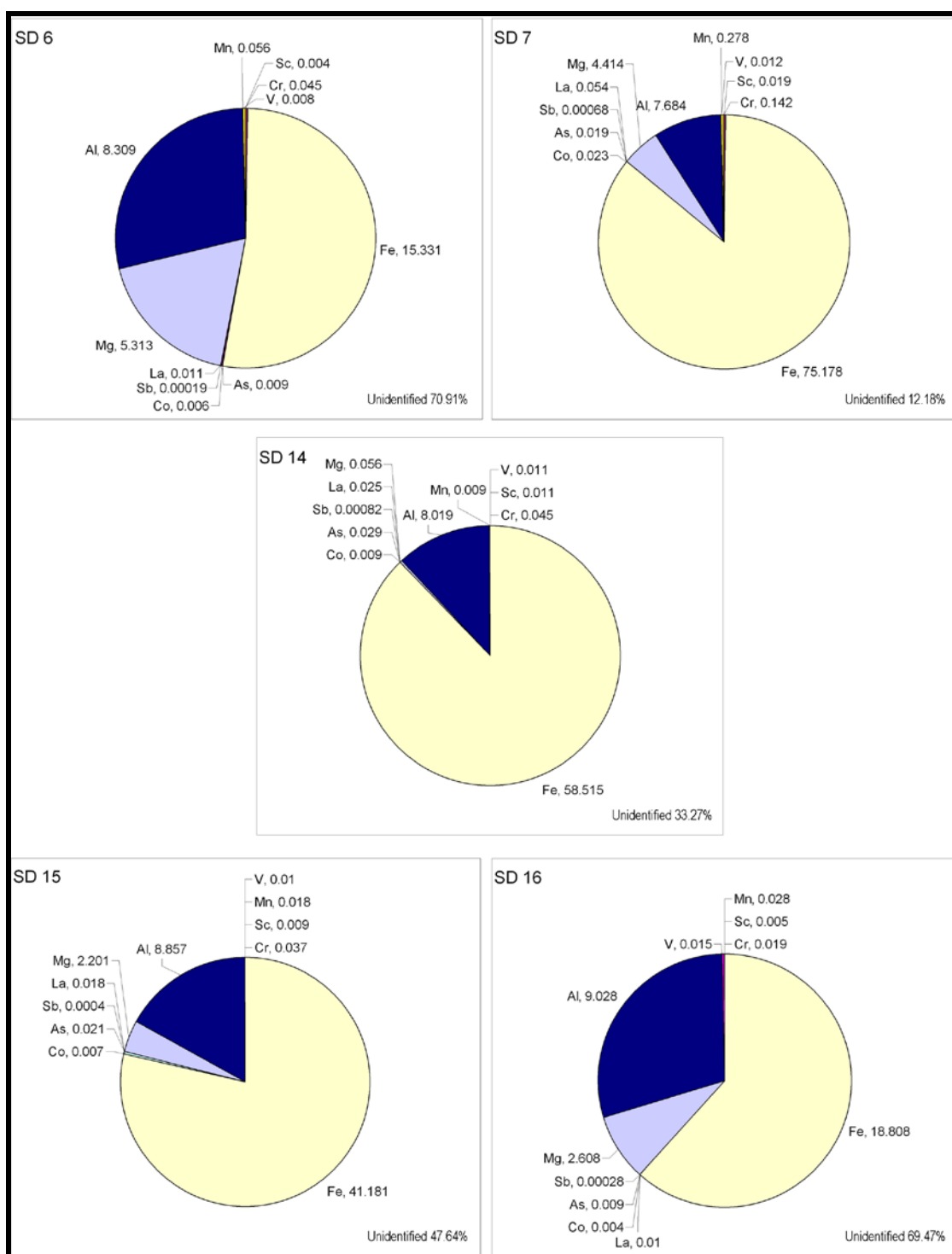


Fig.26. Pie-charts showing elemental composition (%) of the SD NAA samples

*The Electron Microscopy EDS Analysis*

Scanning Electron Microscopy (SEM) uses a focused electron beam to scan areas of a solid sample, causing as a result the samples to emit secondary electrons (X-rays) which may be collected and mapped.<sup>143</sup> Energy Dispersive Spectroscopy is a procedure for identifying and quantifying the elemental composition of sample areas through the identification of the characteristic X-rays produced as a result of the focused electron beam. The resulting X-rays are detected by an energy dispersive spectrometer, which is a solid state device that discriminates among differing X-ray energies.<sup>144</sup>

Samples from SD 14 and SD 15 were submitted to Michael Pedleton of the Texas A&M University Microscopy Laboratories for EDS analysis. The samples were primed with carbon (C), as opposed to gold (Au), in order to avoid concealing the presence of any gold mica. Elemental analysis was fairly uniform in the relative proportions of elements in the two samples (fig. 27). Although the sampling size is small, this is one further indication that the main ceramic assemblage does consist of the same whole, suggesting once more a single wrecking event. Whereas Al and Fe were also among the most prominent elements in the results of the NAA, the EDS analysis testifies to a relatively high concentration of Si, an element that the NAA analysis conducted could not identify. As with the NAA, it is hoped that the EDS analysis may aid in establishing a provenience for the wreck in the future. Results from the EDS technique are considered

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<sup>143</sup> Pennsylvania State University's Materials Characterization Laboratory (2007) presents an overview of SEM and EDS.

<sup>144</sup> Pennsylvania State University's Materials Characterization Laboratory (2007) SEM and EDS.

reliable, although it should be stressed once more that the ceramics have been in conservation and storage for three decades.

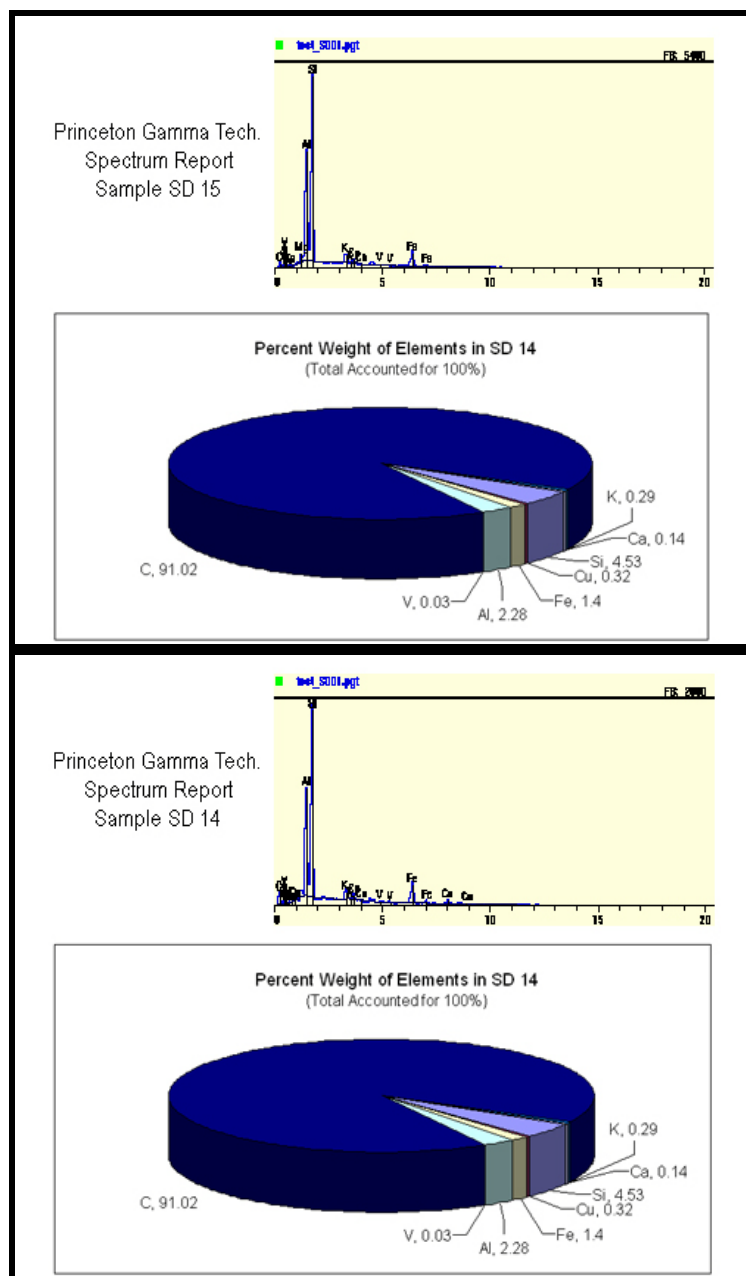


Fig. 27. Percent weight of elements in the EDS samples

## CHAPTER VIII

### CONCLUSIONS

The Sheytan Deresi site has certainly retained some of its secrets even after three decades of research into the cultural material that was raised during the 1975 excavation. We are, however, at a point where one can claim a fair level of understanding of the site and its artifact assemblage.

To begin with, given the results of the scientific analyses, and in particular those of the petrographic analysis, one can say with a significant degree of certainty that the SD ceramics share the same mineralogical source of origin, and therefore form a single assemblage. It has proved difficult, however, to narrow down that point of origin past the regional level. Having determined, through luminescence dating, a general time frame for the assemblage, an effort was made to compare petrographic and NAA signatures with other sites in an attempt to narrow the field of possibilities even further.

Petrographic analysis of ceramics associated with a Late Bronze Age kiln at Kommos resulted in the creation of six reference groups. SD petrographic samples had most in common with Reference Group 6 (coarse red fabric with schist), which is tentatively traced to the ophiolite series near the neighboring villages of Sivas and Kouses.<sup>145</sup> It is important, however, to bear in mind what a recent study comparing thin-section

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<sup>145</sup> Joyner and Day 2001, 152-5. Unfortunately, in this case Reference Group 6 proved to be associated with the furniture of the kiln rather than its products. Garrigós, Kilikoglou, Day 2001, 354.

petrography and NAA from Early Minoan pottery has highlighted, i.e., the complex relationship between the composition of a ceramic body, its origin, and the choices and practice behind the formation of its clay fabric.<sup>146</sup> While petrographic analysis of the non-plastic components of pastes was ( in this study) able to clearly differentiate between well-defined stylistic groups, dissimilar fabrics from the same geographical area as well as pottery made with similar clay fabrics and fired in similar fashion but originating from different areas, complicate provenience studies.<sup>147</sup> The particular study also addresses issues with the NAA data produced when examining the same stylistic groups. Whereas the limited SD samples show a fair degree of homogeneity among themselves in terms of NAA results, in-group discrepancies within the aforementioned study ranged from marginal to total. A number of possible reasons for this phenomenon include an actual source difference, a paste recipe difference, diagenetic effects, and a combination of the above.<sup>148</sup> As a result of the comparisons, the authors of the study concluded by stressing the necessity of adopting an approach that integrates mineralogical, technological, and stylistic information in order to attempt to answer to the natural and human sources of variation.<sup>149</sup> The same approach was adopted by this work, although restricted to the study of a single assemblage, and without foreknowledge of provenience.

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<sup>146</sup> Day et al. 1999, 1034.

<sup>147</sup> Day et al. 1999, 1034.

<sup>148</sup> Day et al. 1999, 1034.

<sup>149</sup> Day et al. 1999, 1034.

The other main source of information pursued with the intent of complementing the scientific analyses, i.e., potential parallels, has not, unfortunately, offered the insight that often derives from them. Temporally, what can be said is that research into parallels has in no way dismissed the Bronze Age date suggested by the luminescence dating, and that in fact some of the best parallels for the assemblage originate from the time period. With the  $1910 \pm 340$  B.C.E weighted luminescence average seeming plausible, culturally and geographically speaking, the balance of the parallels examined does tend to support Margariti in classifying the assemblage as falling within a (Middle) Minoan sphere of influence.<sup>150</sup> It is worth noting, however, that Rutter has recently compared the SD small jug type with a group of *imported* small closed vessels from Kommos.<sup>151</sup> The group under consideration is composed of medium-coarse, reddish-brown burnished fabric, with white angular and sub-angular grit, smaller dark gray and black subrounded and subangular grit, as well as reddish-brown dark reddish-brown subrounded grit.<sup>152</sup> In his analysis of the material, Rutter notes that features such as thickened horizontal or sloping lips, the burnished reddish-brown and often somewhat mottled exteriors, the emphasis on articulated bases, the distinct but usually not sharply-offset necks on closed forms, and the penchant for multiple fine grooves at the transition from neck to shoulder, features that are shared for the most part with the Sheytan Deresi assemblage (save the articulated bases), are all difficult to parallel in Minoan pottery, and instead seem common to contemporary central and Southwest Anatolia.<sup>153</sup> He suggests the Gulf of

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<sup>150</sup> Margariti 1998b, 51-62.

<sup>151</sup> Rutter 2006, 138-53.

<sup>152</sup> Rutter 2006, 139, 141.

<sup>153</sup> Rutter 2006, 149.

Izmir and the Gulf of Kerme as the probable source area for this group of ceramics found at Kommos and throughout the island of Crete during the LMII-LMIIIA1 period.<sup>154</sup> While the similarities between the two assemblages could be indicative of a possible relationship, it is important to keep in mind that there are also significant differences. To begin with, virtually all of the ceramics from Kommos can be attributed to a single type of small closed jug.<sup>155</sup> Although this type is indeed fairly similar to the SD small jug type, the SD examples do not carry a lower lug (or more rarely a handle) typical of the Kommos type, do not share a common base with any of the three Kommos articulated base types, are not as round in overall profile, and do not demonstrate the marked ribbing that appears to be typical of the Kommos assemblage. A direct relationship, therefore, between the two assemblages may make for a weak argument. On the other hand, little precludes the two from sharing in a common tradition, perhaps at different points along the temporal and geographical range. A southwestern Anatolian origin would agree with what other information can be derived from the Sheytan Deresi site and artifacts. Certain distinctive features of the assemblage such as the plastic knob on the strap-handled amphorae, the incised horizontal handles, the horizontal grooves on the pithoi shoulders, and even variants of the plastic decoration on either side of the krater handles, can be seen, albeit on unrelated shapes, in the Middle and Late Bronze Age ceramics of the Smyrna region.<sup>156</sup> With the current level of knowledge, further speculation as to the provenience of the wreck or the cultural identity of the cargo cannot

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<sup>154</sup> Rutter 2006, 149,151.

<sup>155</sup> Rutter 2006, 139.

<sup>156</sup> Bayne 2000, 71-8.



offer reliable conclusions, beyond what the petrographic analysis has suggested; areas within the regions of Greece, Anatolia, and Cyprus.

The scarcity of strong ceramic parallels may indicate the local nature of the vessel and cargo. As particularly good parallels do not appear in any contemporary regional land site, one could propose a limited local distribution of the types that appear at Sheytan Deresi. There is also another possibility, tentatively suggested by the closest parallels to the SD piriform amphora type. The main difference between SD 6, SD 7, and SD 8 and the Middle Minoan II tall amphorae recovered from the Room of the Jars in Knossos relates to their base,<sup>157</sup> which in the case of the SD amphorae is significantly narrower. In fact, one may note that the SD pithoi also have particularly narrow bases. In addition, a number of features of the SD pithoi suggest that these vessels were made for mobility and transportability, and not for a stationary purpose. According to Christakis, who undertook a thorough study of Cretan Bronze Age pithoi, mobile vessels usually have a narrow base, and the maximum diameter is either at the middle or more frequently at the very upper part of the body, while pithoi under 1 meter in height offer increased maneuverability for accessing contents.<sup>158</sup> At the same time, restricted mouths allow for security and better preservation of contents.<sup>159</sup> Zemer comments on ceramics similar to

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<sup>157</sup> MacGillivray 1998, 38.

<sup>158</sup> Christakis 2005, 47-8, fig. 16. It may be worth noting that even within this exhaustive study of Cretan Bronze Age pithoi, the correlation between either of the SD pithos types and any single group identified by Christakis remains poor. The strap-handled pithos type most resembles group 67, although in the latter there is an additional set of handles, the handles do not project above the rim, and they are not entirely vertical. The handleless, ovoid-conical pithos type resembles none of the types as there are none depicted without handles.

<sup>159</sup> Christakis 2005, 46.

the SD strap-handled pithos type stating that their basket handles enhance suitability for transport, while their frequent occurrence in underwater archaeological contexts may suggest a special connection to maritime trade.<sup>160</sup> Christakis presents ample evidence for the use of pithoi in the maritime transport of goods both originating from Crete and subsequently exported, as well as originating from various sites around the Aegean and Eastern Mediterranean, and then imported to Crete.<sup>161</sup> Could it be, therefore, that the reason it has proved so difficult to uncover strong parallels for the SD ceramic assemblage is that the main cargo vessels have been modified for maritime transport and we simply do not have contemporary wrecks from the region to make any connections? If the cargo is specialized, this would tend to discount the theory of the Sheytan Deresi vessel having been such a small-scale occasional trading vessel of opportunity, that it would not carry any personal artifacts, tools, or the like.

A number of the pithoi in the Christakis study that have been found outside of Crete appear fairly similar to Minoan pithos types, raising the question as to whether they were imported from Crete or locally made, imitating Cretan Bronze Age pithoi. According to the same author, an examination of the “exported pithoi” recovered from the rest of the Aegean has shown that morphological differences exist from the Cretan versions and

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<sup>160</sup> Zemer 1977, 31

<sup>161</sup> Christakis (2005, 57) states that “the transport of goods is also proved by the presence of LM pithoi originating in Naxos, Cyprus, and Italy and by finds of storage jars from Egypt and Syria-Palestine in the coastal settlement of Kommos and again by the presence of Cypriot pithoi at Cannatello near Agrigento. Three Mycenaean pithoi were recovered in the ninth magazine of the West Magazine Complex at the palace of Knossos: probably shipped from mainland Knossos.” He continues with evidence for “pithoi similar to Cretan Bronze Age specimens ... recovered at the sites of Akrotiri, Thera, Phylakopi, Melos, Miletus, Karpathos, Saros and Kasos, Iasos in Asia Minor, Cyprus, and Sardinia.”

thus they should be classified as Minoanizing, not Minoan.<sup>162</sup> This suggestion corresponds well with the emerging understanding of the extent and influence of the Minoan civilization along the Anatolian coast and the Aegean islands. Middle Minoan pottery, mostly attributed to the Middle Minoan II period, including open shapes not suitable for containers of Minoan exports, have been found along an island chain including Kasos, Karpathos, Rhodes, Kos, Chalkis, Kalymnos, Telos, Nisyros, Astypalea, and Samos; sherds have also been found on the Anatolian coastal sites of Miletus, Iasos, and Knidos and Didyma.<sup>163</sup> Many of the aforementioned sites are included in a list of islands in the vicinity that have reported Minoan sites, a list that also includes Seskli, Chalke Saros and Samothrake.<sup>164</sup> While Niemeier speaks of “a system of ‘Minoanized’ settlements in the Eastern Aegean” he refers to as the “Eastern String,”<sup>165</sup> at the same time that increasing decentralization in interregional trade begins to emerge.<sup>166</sup> In such a world, small-scale local pottery production such as that practiced outside the palatial centers of Crete may have precluded product uniformity concomitant with mass production.<sup>167</sup> Such a practice could help explain why traits of the SD ceramic assemblage are reminiscent of Minoan and Anatolian pottery features, but not directly linked to them.

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<sup>162</sup> Christakis 2005, 57.

<sup>163</sup> Wiener 1991, 328; Margariti 1998b, 57.

<sup>164</sup> Margariti 1998b, 56.

<sup>165</sup> Niemeier 1984, 206.

<sup>166</sup> Sherratt 1999, 163-211.

<sup>167</sup> Margariti 1998b, 60.

The I.N.A. first attempted sieving of waterlogged contents of recovered ceramic vessels during the excavation at Serçe Limani in the late 1970s.<sup>168</sup> Consequently, no information on organic remains (or residues) was recovered at the time of the Sheytan Deresi excavation a few years earlier. Performing analyses such as X-ray fluorescence, infrared spectroscopy, or chromatography, which have proved successful elsewhere,<sup>169</sup> would likely produce dubious if any results at this point due to the fragmented ceramics' prolonged stay in a high-energy sandy underwater environment, followed by contamination and conservation treatments over the past three decades. At the same time, however, resins tend to be better preserved in underwater contexts as compared with land sites resin degradation is accelerated by soil bacteria;<sup>170</sup> perhaps upon completion of the current conservation treatment, an attempt could be made to collect organic residues from certain of the ceramic vessels, most promising being SD 10, SD 13 and perhaps SD 6. At this point in time, however, another possible indication of a potential origin or port of call for the vessel is disappointingly absent. Any venture to ascertain the contents of the ceramics from Sheytan Deresi, should there have been any, is unfortunately based solely on speculation. Organic residue analyses from Bronze Age pithoi alone have identified the presence of olive pits, grape seeds, grain, barley, wheat, fava beans, pears, *phlomis fruticosa*, lentils, beans, chickpeas, almonds, figs and barley flour and fish.<sup>171</sup> Beyond olive oil, liquid contents have included resonated wine, wine

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<sup>168</sup> Cemal Pulak, personal communication, December 2007.

<sup>169</sup> Tzedakis and Martlew 1999, 28-29.

<sup>170</sup> Formenti and Duthel 1996, 84.

<sup>171</sup> Christakis 2005, 51.

combined with a barley product, honeyed wine or mead.<sup>172</sup> At the same time, contents have also included inorganic materials such as colored pigments, plaster or clay.<sup>173</sup> SD 9 reminds us of the possibility that the ceramics themselves were intended as a trade item, as an open shape such as a krater is not a suitable seaborne container.

Although it seems we cannot yet determine the original source of the cultural material recovered from Sheytan Deresi site, it is clear that the immediate source of the artifacts must have been a watercraft of sorts, given the distance of the main archaeological site from shore. Furthermore, the distribution of the ceramic fragments on the seafloor suggests that the majority of the ceramic vessels fractured upon impact with the seabed, given the distinct concentrations of sherds belonging to single identifiable vessels (fig. 28).

This theory is also supported by the fact that SD 9 and SD 10 were found intact resting on the sediment. That all the ceramics seem to have begun their descent towards the seafloor approximately at the same time is suggested by the proximity of each identifiable concentration of fragments to one another. At the same time, the artifact distribution, in addition to the lack of hull fragments, personal items, weights, anchors, lamps, tools, etc., suggest that the boat carrying the cargo did not come to rest on the seafloor near the identified site; during at least this phase of the wrecking event, the ship itself likely did not founder.

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<sup>172</sup> Tzedakis and Martlew 1999, 144-5, 161, 167.

<sup>173</sup> Christakis 2005, 51.

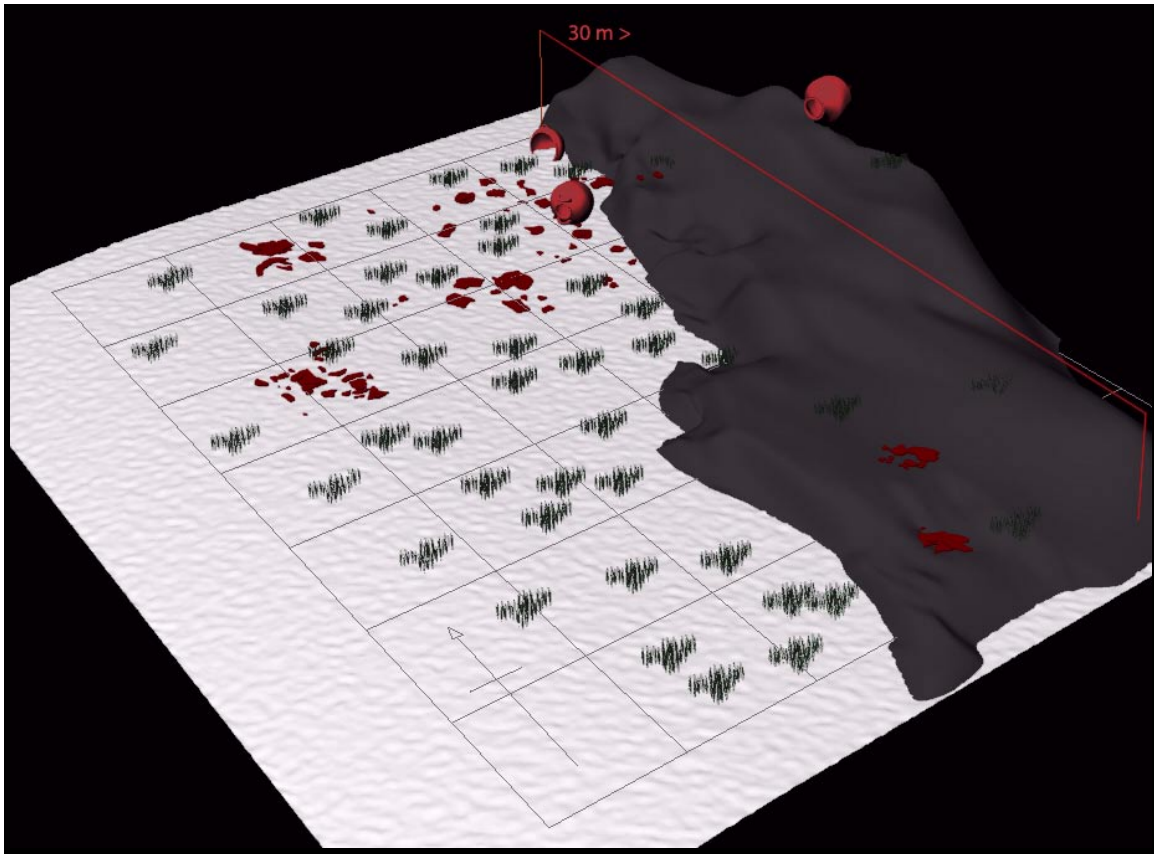


Fig. 28. Three-dimensional reconstruction of the Sheytan Deresi site

To a large degree, the possibility of the main ceramic cargo being jettisoned over the side of the vessel in an attempt to lighten the load can also be discounted. After all, removing the small ceramics would not have had much of an effect to this end, while the discovery of apparent ballast stones does not favor this scenario either. The very concentrated nature of the site also does not support such a possibility, as in that case one would expect a greater distance between the ceramics, especially taking into account the size of the pithoi. For a rather small vessel, which must have carried a small crew, to

discard seven or more pithoi alone within 10-12m of each other, while under threat of foundering, would have been a difficult task.

There are, however, instances of SD ceramic fragments that do not belong to identifiable concentrations surrounding them. Some of these fragments are buried sufficiently deep in sediment that their position precludes movement from modern visitors to the site.<sup>174</sup> Reasonable explanations for this phenomenon would be an impact between the intact ceramic vessels while on board the boat (eg. during a storm) or against the side of it, or an impact between the ceramic vessels themselves close to or at the surface. Evidence continues to point towards a synchronous deposition event in order to explain the distribution of the ceramics belonging to the main assemblage.

There may also be a number of ceramics originally part of the cargo that are presently unaccounted for, something suggested by the related vessels, pithos 1.10.81 and the unnumbered amphora, that found their way to the Bodrum Museum of Underwater Archaeology. The fact that pithos SD 13 was located 30 meters from the main site suggests that it floated on the surface prior to sinking, while additional vessels may have floated away, as indicated by the large sherds and handle identical to those of SD 10 that was discovered near the coastline 100 meters away from the site.<sup>175</sup> These fragments,

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<sup>174</sup> Bass (1976, 295) does consider the possibility of the sight being visited by looters between the 1973 survey and 1975 excavation due to the fact that, unlike in 1973, no loose sherds were discovered during the 1975 season on the rocky outcrop. In addition, he notes there were few joins for sherds discovered on the rocks in 1973, whereas most fragments excavated from the sand in 1975 could be reassembled more or less completely.

<sup>175</sup> Bass 1976, 295.

however, may also be the sole clue as to the final resting place of the ship that originally carried the recovered cargo.

Having theoretically dismissed the scenario of the ceramics on the main site resulting from jettison and the boat itself having come to rest within the main site, the most reasonable scenario remaining is that of a partial or complete capsizing of the vessel. The location of the site approximately 100 meters off the easterly point of the bay suggests that the ship was in the process of rounding the cape when the wrecking occurred. As Margariti notes, the Gulf of Kerme does not seem to hide navigational hazards such as reefs or shallows and, therefore, it was most likely a violent gust of wind such as the ones that Sheytan Deresi is known for, that may have hit the vessel unexpectedly as it was entering the bay, causing it to list past the critical point.<sup>176</sup> It is therefore unclear if the ceramic fragments found near shore are indicative of a single or more ceramic vessels that floated away and subsequently hit the rocks along the coast, or whether the boat itself, still with a number of artifacts on board, broke up against the shore after having been driven there by the wind and waves.

At this point, it is necessary to pause and acknowledge that there are a number of other possible explanations that could account for the same archaeological record. To begin with, there is no evidence of the boat itself and the only other plausibly contemporary shipwreck, currently being excavated off the island of Pseira, has not, as of yet,

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<sup>176</sup> Margariti 1998b, 8.



produced any such evidence either.<sup>177</sup> At the same time, there are also no iconographical sources that are particularly useful in reconstructing a vessel from this time period. We must therefore entertain the concept that the boat may have been constructed in something other than wood. A skin boat, should it be capable of carrying such a load, and should it have actually sunk with the ceramic assemblage, would plausibly leave no evidence of its presence. Additionally, a very small coastal cruiser may not have carried numerous personal items or tools to begin with, and the fact that one or more anchors are “missing” from the record archaeologists uncovered does not necessarily indicate that they were not there. If, however, one takes into account the recovered ceramic vessels, the additional amphora and pithos from the Bodrum Museum, as well as the three additional pithoi and four additional amphorae known from their fragments,<sup>178</sup> the vessel carrying such a cargo could not have been so entirely small. Although a modest cargo to travel particularly long distances, it is not likely that the Sheytan Deresi vessel engaged in such small-scale opportunistic trade as has been suggested, especially if one considers the theory of the cargo itself being of a specialized maritime nature.

In conclusion, taking into consideration the extensive research undertaken by Bass, Margariti, and the author, the results of the recent scientific analyses, as well as the in situ archaeological record, it may be that the possibly (Minoanizing) specialized ceramic assemblage of Sheytan Deresi stood witness to a fairly small Middle Bronze Age coastal trading vessel that capsized rounding a dangerous cape, not far from its point of origin.

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<sup>177</sup> Hadjidaki 2005.

<sup>178</sup> Bass 1976, 302.

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## APPENDIX A

## SD SAMPLES SUBMITTED FOR ANALYSES

SAMPLE	SD 6	SD 7	SD 14	SD 15	SD 16
<b>SITE</b>	Sheytan Deresi	Sheytan Deresi	Sheytan Deresi	Sheytan Deresi	Sheytan Deresi
<b>CONTEXT</b>	Sand	Sand	Sand	Sand	Sand/Rock
<b>PROVENIENCE</b>	NE Quadrant	NE Quadrant	NW Quadrant	NW Quadrant	SE Quadrant
<b>VESSEL FORM</b>	Piriform Amphora	Piriform Amphora	Handleless Pithos	Handleless Pithos	Handleless Pithos
<b>PART</b>	Body	Body	Body	Body	Body
<b>SIZE</b> Max L.	69.3 mm		97.7 mm	66.2 mm	79.0 mm
Max W.	50.8 mm		62.1 mm	46.6 mm	55.3 mm
Th.	5.2 - 7.8 mm		7.8 - 13.3 mm	7.6 - 11.3 mm (4.2 mm worn edge)	10.1 - 12.6 mm (5.4 mm worn edge)
<b>WEIGHT</b>	33.0 g		74.3 g	38.4 g	47.1 g
<b>DEC/UND</b>	UND		UND	UND	UND
<b>TYPE</b>	Coarse		Coarse	Coarse	Coarse
<b>TREAT - I</b>	Rough		Rough	Rough	Somewhat Rough
<b>TREAT - E</b>	Rough		Somewhat Rough	Somewhat Rough	Rough
<b>POL - I</b>	Not Polished		Not Polished	Not Polished	Not Polished
<b>POL - E</b>	Not Polished		Not Polished	Not Polished	Not Polished
<b>SLIP - I</b>	None	None	None	None	None
<b>SLIP - E</b>	None	None	Present	Present	Present
<b>COL - I</b>	5/6-4/6 7.5YR		6/4 2.5YR & 7/8 5YR	4/6 5YR	6/6 5YR - 4/4 5YR - 3/2 7.5YR
<b>COL - E</b>	6/6 5YR - 3/4 2.5YR		4/4 2.5 YR	3/6 2.5 YR - 3/4 2.5YR (slip)	6/4-5/4 5YR
<b>COL - P</b>	6/6 10R		3/2 5YR	3/4 10R	6/8 2.5YR - 3/4 2.5YR
<b>CARB</b>	None		None	Present (diffuse core margins)	None
<b>BINOCTEMPER</b>	angular, chalky, white, tan, little mica, numerous small holes, finer clay		blocky, angular, white, tan, little quartz, little mica, glue	angular, chalky, dull, blocky, white, tan, some mica	chalky, blocky, angular, matte, shiny, white, tan, little mica, little quartz
<b>TEMPER SIZE</b>	fine sand		medium sand	medium sand	medium sand

## APPENDIX B

### LUMINESCENCE DATING PROCEDURES

#### *Procedures for Thermoluminescence Analysis of Pottery*

##### Sample preparation -- fine grain

The sherd is broken to expose a fresh profile. Material is drilled from the center of the cross-section, more than 2 mm from either surface, using a tungsten carbide drill tip.

The material retrieved is ground gently by a corundum mortar and pestle, treated with HCl, and then settled in acetone for 2 and 20 minutes to separate the 1-8  $\mu\text{m}$  fraction.

This is settled onto a maximum of 72 stainless steel discs.

##### Glow-outs

Thermoluminescence is measured by a Daybreak reader using a 9635Q photomultiplier with a Corning 7-59 blue filter, in  $\text{N}_2$  atmosphere at  $1^\circ\text{C/s}$  to  $450^\circ\text{C}$ . A preheat of  $240^\circ\text{C}$  with no hold time precedes each measurement. Artificial irradiation is given with a  $^{241}\text{Am}$  alpha source and a  $^{90}\text{Sr}$  beta source, the latter calibrated against a  $^{137}\text{Cs}$  gamma source. Discs are stored at room temperature for at least one week after irradiation before glow out. Data are processed by Daybreak TLApplic software.

##### Fading test

Several discs are used to test for anomalous fading. The natural luminescence is first measured by heating to  $450^\circ\text{C}$ . The discs are then given an equal alpha irradiation and stored at room temperature for varied times: 10 min, 2 hours, 1 day, 1 week and 8 weeks.

The irradiations are staggered in time so that all of the second glows are performed on the same day. The second glows are normalized by the natural signal and then compared to determine any loss of signal with time (on a log scale). If the sample shows fading and the signal versus time values can be reasonably fit to a logarithmic function, an attempt is made to correct the age following procedures recommended by Huntley and Lamothe.<sup>179</sup>

### Equivalent dose

The equivalent dose is determined by a combination additive dose and regeneration.<sup>180</sup> Additive dose involves administering incremental doses to natural material. A growth curve plotting dose against luminescence can be extrapolated to the dose axis to estimate an equivalent dose, but for pottery this estimate is usually inaccurate because of errors in extrapolation due to nonlinearity. Regeneration involves zeroing natural material by heating to 450°C and then rebuilding a growth curve with incremental doses. The problem here is sensitivity change caused by the heating. By constructing both curves, the regeneration curve can be used to define the extrapolated area and to correct for sensitivity change by comparing it with the additive dose curve. This works where the shapes of the curves differ only in scale (i.e., the sensitivity change is independent of dose). The curves are combined using the “Australian slide” method in a program developed by David Huntley of Simon Fraser University.<sup>181</sup> The equivalent dose is taken

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<sup>179</sup> Huntley and Lamothe 2001.

<sup>180</sup> Aitken 1985.

<sup>181</sup> Prescott et al. 1993.

as the horizontal distance between the two curves after a scale adjustment for sensitivity change. Where the growth curves are not linear, they are fit to quadratic functions. Dose increments (usually five) are determined so that the maximum additive dose results in a signal about three times that of the natural and the maximum regeneration dose about five times the natural. If the regeneration curve has a significant negative intercept, which is not expected given current understanding, the additive dose intercept is taken as the best, if not fully reliable approximation.

A plateau region is determined by calculating the equivalent dose at temperature increments between 240° and 450°C and determining over which temperature range the values do not differ significantly. This plateau region is compared with a similar one constructed for the b-value (alpha efficiency), and the overlap defines the integrated range for final analysis.

### Alpha effectiveness

Alpha efficiency is determined by comparing additive dose curves using alpha and beta irradiations. The slide program is also used in this regard, taking the scale factor (which is the ratio of the two slopes) as the b-value.<sup>182</sup>

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<sup>182</sup> Aitken 1985.

## Radioactivity

Radioactivity is measured by alpha counting in conjunction with atomic emission for  $^{40}\text{K}$ . Samples for alpha counting are crushed in a mill to flour consistency, packed into plexiglass containers with ZnS:Ag screens, and sealed for one month before counting. The pairs technique is used to separate the U and Th decay series. For atomic emission measurements, samples are dissolved in HF and other acids and analyzed by a Jenway flame photometer. K concentrations for each sample are determined by bracketing between standards of known concentration. Conversion to  $^{40}\text{K}$  is by natural atomic abundance. Radioactivity is also measured, as a check, by beta counting, using a Risø low level beta GM multiscaler system. About 0.5 g of crushed sample is placed on each of four plastic sample holders. All are counted for 24 hours. The average is converted to dose rate following Bøtter-Jensen and Mejdahl<sup>183</sup> and compared with the beta dose rate calculated from the alpha counting and flame photometer results.

Both the sherd and an associated soil sample are measured for radioactivity. Additional soil samples are analyzed where the environment is complex, and gamma contributions determined by gradients after Aitken.<sup>184</sup> Cosmic radiation is determined after Prescott and Hutton.<sup>185</sup> Radioactivity concentrations are translated into dose rates following Adamiec and Aitken.<sup>186</sup>

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<sup>183</sup> Bøtter-Jensen and Mejdahl 1988.

<sup>184</sup> Aitken 1985.

<sup>185</sup> Prescott and Hutton 1988.

<sup>186</sup> Adamiec and Aitken 1998.

### Moisture Contents

Water absorption values for the sherds are determined by comparing the saturated and dried weights. For temperate climates, moisture in the pottery is taken to be  $80 \pm 20$  percent of total absorption, unless otherwise indicated by the archaeologist. Again for temperate climates, soil moisture contents are taken from typical moisture retention quantities for different textured soils,<sup>187</sup> unless otherwise measured. For drier climates, moisture values are determined in consultation with the archaeologist.

### *Procedures for Optically Stimulated or Infrared Stimulated Luminescence of Fine-grained Pottery.*

Optically stimulated luminescence (OSL) or infrared stimulated luminescence (IRSL) on fine-grain (1-8  $\mu\text{m}$ ) pottery samples is carried out on single aliquots following procedures adapted from Banerjee et al.<sup>188</sup> and Roberts and Wintle.<sup>189</sup> Equivalent dose is determined by the single-aliquot regenerative dose (SAR) method.<sup>190</sup>

The SAR method measures the natural signal and the signal from a series of regeneration doses on a single aliquot. The method uses a small test dose to monitor and correct for sensitivity changes brought about by preheating, irradiation or light stimulation. SAR consists of the following steps: 1) preheat, 2) measurement of natural signal (OSL or IRSL), L(1), 3) test dose, 4) cut heat, 5) measurement of test dose signal, T(1), 6)

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<sup>187</sup> Brady 1974, 196.

<sup>188</sup> Banerjee et al. 2001.

<sup>189</sup> Roberts and Wintle 2001.

<sup>190</sup> Murray and Wintle 2000.

regeneration dose, 7) preheat, 8) measurement of signal from regeneration,  $L(2)$ , 9) test dose, 10) cut heat, 11) measurement of test dose signal,  $T(2)$ , 12) repeat of steps 6 through 11 for various regeneration doses. A growth curve is constructed from the  $L(i)/T(i)$  ratios and the equivalent dose is found by interpolation of  $L(1)/T(1)$ . Usually a zero regeneration dose and a repeated regeneration dose are employed to insure the procedure is working properly. For fine-grained ceramics, a preheat of 240° C for 10 seconds, a test dose of 1.8 Gy, and a cut heat of 160° C are currently being used, although these parameters may be modified from sample to sample.

The luminescence,  $L(i)$  and  $T(i)$ , is measured on a Risø TL-DA-15 automated reader by a succession of two stimulations. First 100 seconds at 60° C of IRSL (880 nm diodes), and second 100 seconds at 125° C of OSL (470nm diodes). The OSL is also called blue stimulated luminescence (BSL). Detection is through 7.5 mm of Hoya U340 (ultra-violet) filters. The two stimulations are used to construct IRSL and OSL growth curves, so that two estimations of equivalent dose are available. Only feldspars are sensitive to IRSL, but they are also sensitive to blue light, but current data suggest that most of the feldspar signal is removed by the IRSL stimulation, so that the OSL signal arises predominantly from quartz. This may mean that the OSL signal does not suffer from anomalous fading, but the procedure is still undergoing study and may be modified in the future.

Alpha efficiency differs among IRSL, OSL and TL on fine-grained materials. The  $b$ -value was measured for OSL and IRSL by adding two alpha irradiations to the SAR

sequence (still maintaining a test dose with beta radiation) and using the difference in slopes between the beta and alpha growth curves to determine the b-value. The b-value for OSL has been found not to vary much and seems to center around 0.6-0.7 for most samples.



## APPENDIX C

## TEXAS A&amp;M NAA CONDITIONS AND PROCEDURES

Short Irradiation Time	30 seconds
Short Irradiation Flux	$2 \times 10^{13}$ n/cm <sup>2</sup> /s
Decay Time before first count	20 minutes
Count time, first count	500 seconds
Standards for pottery, first count	SRM-1633a (coal fly ash); SRM-688 (basalt rock for Ca); Ohio Red Clay (quality control)
Elements determined from short irradiation	Al, Ca, Dy, Mn, Ti, V
Long irradiation time	14 hours
Long irradiation flux	$2 \times 10^{13}$ n/cm <sup>2</sup> /s
Decay time before second count	1 week
Count time, second count	2000 seconds
Standards for pottery, second count	SRM-1633a (coal fly ash); Ohio Red Clay (quality control); SRM-688 (quality control);
Elements determined from second count	Na, As, La
Decay time before third count	3-4 weeks after second count
Count time, third count	3 hours
Elements determined from third count	Ba, Lu, Nd, Sm, U, Yb, Ce, Co, Cs, Eu, Fe, Hf, Ni, Rb, Sb, Cr, Sc, Sr, Ta, Tb, Th, Zn, Zr

After (Glowacki and Neff 2002, 4)

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